FACTORY
MANAGEMENT and MAINTENANCE
L. C. MORROW
Editor

SEPTEMBER 1935

Lest We Forget

WITH the Labor Disputes and Social Security Acts well under the wire and the tax bill in by a nose, the adjournment of Congress gives industry about four months in which to adjust itself to these measures.

This is not to say that the new laws should be accepted without protest and without attempts to better them. Laws can be amended even before they go into effect. So there is something for industry to think about during the recess.

And, lest we forget that we are on parole, our thoughtful legislators are leaving with us some new bills. They afford added grist for the think mill, evidently will give the new Congress something to sink its teeth into.

ONE of the new bills is the Textile Control Bill that would set up a Commission with power to issue licenses to firms manufacturing textile products.

One of the features of this bill is that use of the mails for the shipment of or correspondence concerning textile products, transmission of money or any other material or information in connection with textile products would be denied to unlicensed manufacturers.

Teeth are contained in the provision that there can be no government money for non-licensed mills, no dealings by such mills with banks that borrow or have borrowed Federal money; and no Federal money can be loaned to states, or other political subdivisions, or carriers, or finance institutions dealing with unlicensed mills.

Yes, it's something to think about, especially the proposal to use the Federal control of the mails as a big stick over industry. The bill has been referred to the House Labor Committee.

And, while our legislators are mending fences, don't forget to think about the Federal Licensing Bill, also recently introduced and referred to the House Interstate Commerce Committee. It is backed by the American Federation of Labor and is sometimes called the A. F. of L. Licensing Bill.

This bill would provide for licensing by the Federal Government of all corporations engaged in interstate commerce. But, wherever it was shown that output of an unlicensed (intrastate) producer interfered with "effective handling" of the output of a licensed producer, the unlicensed output would be brought under license after hearing.

A limit on corporation surpluses would be set. Surplus in excess would be distributed to the stockholders. But if dividends the year before had been as much as 10 per cent, this surplus would be divided among employees.

But, most interesting of all the provisions, it seems at the moment, is the one whereby rates of pay of employees would be increased and hours of work decreased in accordance with gains in the productive efficiency of industry arising from increased mechanization and improvements in technological methods.

THE objective of the provision just referred to is "to the end that employees shall have an equitable participation in the output of industry, and that mass purchasing power may keep pace with the productive accomplishment of industry."

Which, of course, is a laudable and blameless objective, but one that is being attained right along. Any increase in standard of living is a measure of the advance toward that objective. Such advances come about by evolution, not legislation. The slight increments, that make a fine showing in the aggregate, are not definitely measurable by individual machine, department, or plant. Even if they were, the measuring, recording, and rate-adjusting bureaucracy necessary to meet conditions would be unsupportable.

These are, indeed, things to think about.

A $50,000,000 expansion and modernization program for General Motors has been announced. Buick is spending $14,500,000. Pictured is one of 60 new drilling and tapping machines for the Buick transmission plant. Seven transmission cases are drilled, tapped, and reamed simultaneously. Here's an example of using technological development in the interest of low costs, wide distribution, increased employment, greater prosperity.

Woodworkers Are Welders Now

An experience in vocational rehabilitation. Shift from wood to steel auto bodies meant new metal-working jobs for old woodworkers—or else relief

HAROLD H. SEAMAN
President, Seaman Body Corporation
Milwaukee

AVERAGE consumption of 250 feet of lumber per body in 1932; average consumption of 50 feet in 1935. There, set up in briefest possible formula, is the problem of vocational rehabilitation that has faced us during the past year or two.

Three years ago, in common with practically all of the automobile industry, we were producing composite bodies. Some of the structural members were steel; most of them were wooden. The trend set in toward steel. Today our bodies, and those of most other body makers, contain no lumber whatever in the structural members. About the only lumber we use is for nailing strips, upholstery moldings, and the like.

Our wood mill department shrank. So did some other types of work—shrank or disappeared. For example, we had a number of men who performed various operations that eventuated in the fabric covering of the top of closed bodies. Now this is all steel. There is no fabric, no panel, and so forth.

Sudden Shift in Trades

In brief, we were faced by a major upheaval both in kind of manufacturing and in kind of employment available in our plant. And it was just as inevitable as, and a good deal more sudden than, the traditional shift from buggy whips to carburetors. There was nothing we could have done, even if we had wanted to, to hold it back.

The manufacturing changes were nothing unprecedented in kind or severity, since the automotive industry is constantly making radical improvements. But the shift in trades within our plant was something else. Most of the woodworking crafts rather suddenly became obsolete and had to be supplanted by steel-working crafts. This change affected about 300 of our men.

In boom times, it would probably have meant no hardship upon the woodworkers to be let out with a dismissal wage. But to let them go now would simply mean putting most of them on the relief rolls. Viewed purely from the management angle, this must unavoidably have a harmful and costly effect upon the morale of our remaining workers. They would feel that they owed us no loyalty, for certainly we would not be giving them a great deal of it.

Simple Way Out

Moreover—and it is unfashionable to admit to such weaknesses, but we suspect most production executives share them—we could not enjoy the prospect of causing so much human misery. It is one thing to fire a man for his own shortcomings, quite another to lay him off for an engineering development which he could no more control than the weather.

Mind you, we did not suddenly bump into this problem on the large scale. It first faced us in miniature when the trend started a couple of years ago. We met it by what struck us as a common sense arrangement. So, when the problem began coming along more frequently, we just went along with the method we had been using. So far it has worked very well. We wish to emphasize this, because it has all been done naturally, at no tremendous expense, and with a minimum of formality or complexity of set-up.

Perhaps the typical shift has been from the wood mill to body-welding. Our woodworkers were experienced hands, with all the skill required for our operations. But there has been in our industry a strong trend toward putting the responsibility for skill squarely on the machine. Fewer and fewer of our production jobs deserve to be termed skilled. More and more are of the kind that any reasonably adaptable man can learn within a week or two.

As our basic policy, we decided that displaced employees should have first call on all new jobs. By this we mean that we do not fire the old man, the woodworker, and then hire at the gate a welder to take his place. Instead, we transfer to a welding job the woodworker whose craft has become obsolete, and teach him welding just as if he were an inexperienced man newly hired off the street. Whenever possible, the transferred workman is given his preference among the various jobs open to him.

It really works out very simply. Throughout our plant most of the men are on gang piece rates—so many cents to the gang for each operation it performs, the money split up among the gang members according to the ratings of their individual crafts. We guarantee each man a given rate of earnings—say 60 cents, or 65 cents, an hour. This is his base rate below which he cannot fall; as long as we keep him at work, we have to pay him this rate.

Welcome to the Gang

So when we transfer a woodworker to a welding gang, or any man from an obsolete craft to any production job, we simply put him in the gang at the guaranteed base rate. We add him to the gang at our expense, not theirs, while he is learning. Consequently he is most welcome, since whatever production he may contribute is just so much more in pocket for his experienced fellow-members. To put it another way, he is working during this beginning period with the gang as a learner, drawing a learner's pay at the expense of the company, but he

is not as yet a member of the gang.

Pretty soon, of course, he gains sufficient skill to keep up with the rest of the gang. He is then transferred formally into the gang, and draws his pay out of the gang piece rate.

If at First—

If, as sometimes happens, he does not catch on, he is tried on another job, usually with another gang. The choice is principally among the following trades: Flash, arc, acetylene, and spot welding; upholstering, painting, trimming, soundproofing, and wiring. It is unusual for a man to fail at his own choice among these new jobs. But if he does fail, if his choice has been unwise, we keep trying him at others.

In a very few cases, it has taken six trials to place the woodworker in a job he can learn. To our regret, there have been a couple of men so "sot in their ways" that they simply could not learn a new trade, and we had to let them go to save their own lives and those of their fellow-workers.

All told, about 300 men have gone through this form of transfer and training from obsolete crafts to current trades. Of these, more than 200 were above 40 years old. The oldest so far is 69. Our record of success at this vocational rehabilitation is therefore somewhere above 99 per cent. Nor, as I have tried to make clear, have we gone to any great trouble or used any exceptional ingenuity.

In general, we start the transferred employee at a job requiring a minimum of skill, and promote the older hands in the gang to more skilled openings. Thus, a wood mill man is likely to start out at something as simple as spot welding, and as soon as he becomes proficient enough to carry his own weight in the gang, the old spot welder becomes an acetylene welder in another department. It has worked out smoothly. The man from the obsolete trade is delighted to find himself still holding a job. And the man whose trade is today in the ascendant finds himself promoted to a better job at better pay.

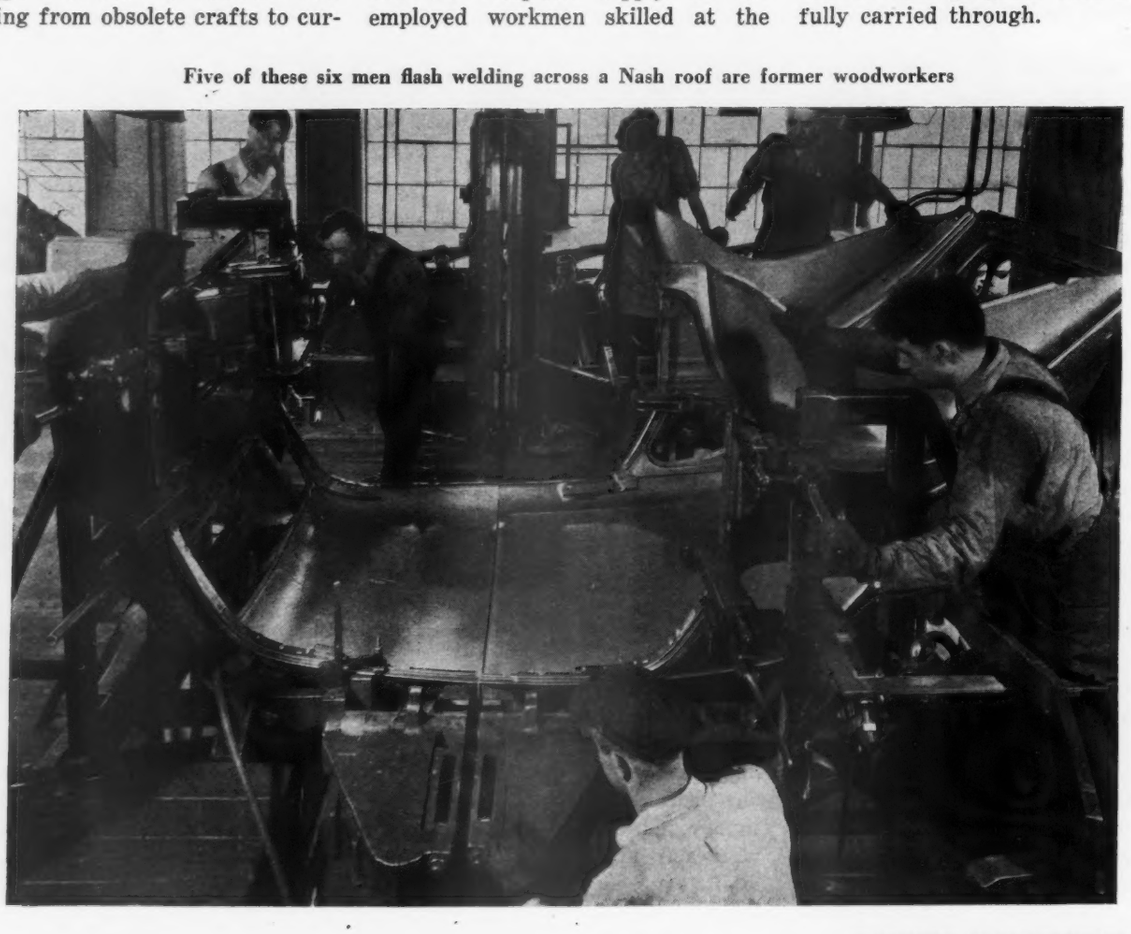
We have been unable to isolate the exact cost of this program. Certainly it has cost us money above what we could have done had we been able to find an adequate supply of unemployed workmen skilled at the newer trades. As it happens, Milwaukee has few industries of our type, and no other body plants. Consequently there never has been any considerable pool of unemployed men in these trades we need. Hiring new men would in most instances have cost us about the same training pay as the old employees get.

At a guess, we have spent $50 per man in this vocational rehabilitation —perhaps $15,000 in all. How much of it we might have saved by hiring men already experienced is something we never can know.

This Is Our Reward

What really matters, of course, is that by following this plan we have inspired a greatly increased loyalty and improved morale among our employees, not only those who have been rehabilitated but also those who have seen this as an instance of our attitude toward our people. And, just as important from the purely selfish standpoint, we do not have to think, when we happen to awaken during the night, of hundreds of men thrown on the public relief rolls as inevitably they must have been had not this program been successfully carried through.

Five of these six men flash welding across a Nash roof are former woodworkers



Research—a "Case" History

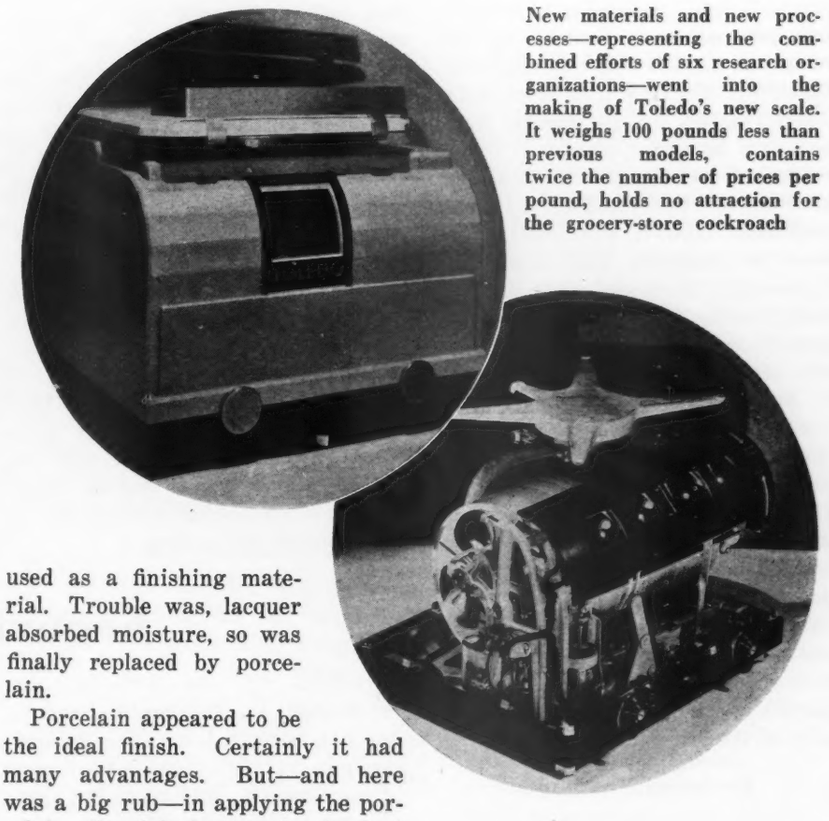
How the need for a lighter housing caused six research organizations to produce an entirely different scale

LEWIS K. URQUHART
Associate Editor

THIS is the story Hugh Bennett told us after we'd finished our cherry pie—the story we choose to refer to, literally enough, as research on a brand-new scale. It is retold here for your benefit because it is a plain, unvarnished tale of what is possible when five concerns and one institution gang up on a product that is good but ought to be better.

It is furthermore an outstanding example of technological development and its broad benefits—in this case a better product for the user's money, the retirement of relatively inefficient equipment, increased employment in making more sales.

Hugh Bennett is president of Toledo Scale Company, one of the five researching companies. The research was done on the Toledo weighing machine you see in corner groceries. The other four companies were General Electric Company, Toledo Synthetic Products, Incorporated, Aluminum Company of America, and Bausch & Lomb Optical Company. The institution that had a finger in the pie was the Mellon Institute.



New materials and new processes—representing the combined efforts of six research organizations—went into the making of Toledo's new scale. It weighs 100 pounds less than previous models, contains twice the number of prices per pound, holds no attraction for the grocery-store cockroach

Big Howl

It all goes back to about 1926. Toledo's scale was a good one. But there was a continuous howl about the weight—not the weight it gave, which was accurate enough—but the weight it weighed.

Seems the Toledo salesmen, when they wanted to demonstrate its superior qualities, couldn't drag it in and out of stores without drafting a couple of clerks into service. Also, whenever the scale had to be moved after the customer bought it, as it did once in a while, the moving was a major operation that did clerks and scale no good. The thing weighed 154 pounds.

There was reason for the weight. Once the scale wasn't so heavy. Originally, or at least during the years just prior to 1923, lacquer was used as a finishing material. Trouble was, lacquer absorbed moisture, so was finally replaced by porcelain.

Porcelain appeared to be the ideal finish. Certainly it had many advantages. But—and here was a big rub—in applying the porcelain, the frit had to be fired at temperatures up around 1,200 to 1,400 degrees Fahrenheit. This made it necessary to heavy up the sections of the base material. Up went the weight—a matter of 50 to 75 pounds.

Aluminum looked to be the answer. An aluminum base would take off that troublesome excess weight. The difficulty, however, lay in the fact that it took 1,200 degrees to fuse the frit, but the aluminum went at 700. Of course, the fusing point of aluminum could be raised by admixture with other, heavier metals, but the net result once more was simply an increase in weight with the Toledo people making no progress fast.

Mellon Institute put its oar in at about this juncture—by request. It suggested phenolic resin as a base material. Sounded good, but phenolic resin, because of the nature of the material and the sawdust filler used in making it, doesn't come in colors suitable for scales. In fact, experience soon proved that women won't buy groceries and meats over anything except a white surface—which is simply impossible with the phenolics.

Put a Fellow to Work

Next suggestion by Mellon was that Toledo look into urea formaldehyde. Light colors and the all-important white would be possible, but of course a lot of research would have to be done. Toledo agreed, endowed a fellowship at Mellon Institute, put its fellow to work on this synthetic resin, whose base was urea formaldehyde, and then waited for the results.

In 1929, if we remember our dates, the results came. The Mellon

fellow, it seems, found what appeared to be the combination, and in the course of his researches had gone to Schenectady to use certain facilities that existed there and nowhere else. General Electric's research engineers were quick to envision a wider use for this new material than the scale housing for which it was originally intended. So in the spring of 1932 a new company—Toledo Synthetic Products, Incorporated—was formed to develop and market this new material, which by this time had been christened Plaskon. Experimental work was done in a pilot plant.

Plaskon was found to be a success, at least in the molding of small products. Now it was time to get down to business and mold that lightweight housing everyone had been howling for. Several years had passed, and the howling had in no wise let up. Remember, the case had to be twice as big as any plastic product that had ever been molded before.

First attempts proved one thing right off the bat. The new scale wasn't going to look anything like the old one. Up to now the Toledo people hadn't thought of that. Now they knew that the mechanical process of molding was going to force tremendous changes in the shape and design not alone of the housing, but also of the scale itself.

Everything Was Suspect

Because so many things had to be changed, Toledo engineers began to question everything.

We won't attempt to set down all their questions, but first they questioned aluminum. It seems it creeps, dimensions of knife edges change, and so on. So they went to Aluminum Company of America, said their say, and came away eventually with a brand-new alloy and a heat-treating process that made it suitable for certain lightweight die-cast parts. Fourteen aluminum parts, one of them the base, weigh 18 pounds.

Alcoa, in turn—the alphabetic designation comes naturally these days—said, what do you think of your paper price charts? We understand the cockroaches like the cement and sometimes raise whole families inside the works. How did the customers like that? Also, didn't the paper wrinkle and make it hard for the proprietor and his men to read what the scale said?

Of course that is only our version of the conversation that took place. Whatever may or may not have been said, the roaches were undisputed facts. Service calls were many on their account, and often expensive. Moreover, the paper's tendency to absorb moisture made the scale readings inaccurate, and the wrinkles made it impossible to set the paper dial close enough to the reading line to avoid parallax—which meant the customer got short weight from a tall clerk looking down, whereas a short clerk looking up didn't do so well by his boss and his store.

No Cockroach Sanctuary

Result was an aluminum sheet 0.005 inch thick. The metal chart finally adopted actually weighs one-third less than the paper one did. More important, of course, is the fact that there's no cockroach fodder anywhere around and from now on Toledo scales won't provide sanctuary for succeeding generations of this unattractive animal.

This aluminum chart, by the way, contains more than 95,000 figures. Danger of distortion and inaccuracy is so negligible that it can be safely disregarded. The chart is so light that it readily comes to rest at the proper figure without swinging back and forth. Because it does not warp, it may be placed so close to the reading line that mistakes caused by parallax are impossible. It weighs but a third of a pound.

Being by this time very much in the habit of looking at things, the Toledo engineers now looked at the lens. Probably someone said let's go and see Bausch & Lomb; maybe we can get a lens that will let us put twice as many figures into the same space.

Which is exactly what they got—a lens system that enables them to include every price from 1 to 60 cents. You see, half of the prices weren't on the old chart. Eighteen was there, for instance. So was 20. But 19 wasn't, and either you couldn't mark pork chops 19 cents a pound or else you had to figure what 3¼ pounds cost in your head.

(Continued on advertising page 66)

Security Act

SIGNED by the President on August 14, the Social Security Act has become law. The analysis given in our July issue *(Provisions of the Security Act)* needs but three changes to complete the story.

The much argued Clark amendment, intended to exempt those employers having their own pension systems approved by the Social Security Board from contributing to the federal pension fund, was dropped. All those qualifying as employers under provisions of the act must contribute. There is, however, a likelihood that some sort of exemption provision will be worked out at the next session of Congress.

Employers or employer-groups desiring to provide unemployment compensation under the so-called Wisconsin plan (see FACTORY, October, 1934, *Unemployment Insurance? It's Coming*), pooled fund, or other system may do so if their state laws permit.

Study of methods of providing economic security and the making of recommendations for legislation will not be a duty of the Social Security Board. The Board will simply administer the bill as enacted.

To make our August analysis complete substitute the following answers under the three questions—

Are there exceptions for private (pension) plans?

No. Exceptions may be enacted in a year or two, however.

Will separate employer or employer-group funds be permitted?

Yes. The Wisconsin plan, pooled funds, or acceptable individual systems will be sanctioned.

What is the Social Security Board?

An independent agency created by the Act to administer provisions of the Act. Three members, appointed by the President, will compose the Board, and will serve terms of 6 years at yearly salaries of $10,000. The Board will perform duties imposed by the Act.

New Products Make New Jobs

How a manufacturer may stick to his regular lines and still develop a specialty or two that will add both to payrolls and profits

GEORGE M. FOSTER
Vice-President, John Morrell & Company
Ottumwa, Iowa

EVERY production executive naturally feels a sincere desire to employ just as many people in these days as he can profitably use. And just as naturally, when volume of sales falls away, he finds it necessary to employ a smaller force.

A method we have been using successfully to combat this tendency when it has shown itself in our business, and which we have been using likewise to increase our proportion of employment in our home communities, has been to go into what might be called specialties. Our business, meat packing, is primarily concerned with producing the staples —hams, bacon, fresh beef and pork, and their byproducts. This business does not inherently employ a large number of people per pound of product, since most of the processes involved in making these staples are comparatively simple and quick.

More Labor—New Products

Suppose, however, that instead of selling a ham when it has been smoked, we put it through some additional processes. We bone it, cook it, stud it with decorative fruits and spices, bake it to a tasty brown, and wrap it in a transparent material to sell to delicatessen stores. We have put a great deal more labor into this specialty than into a mere smoked ham. It is no longer just a ham similar to a number of other top-quality hams; it has become a tidbit which looks different, tastes different and deserves a differential price in recognition of this distinction.

Multiply that one ham by several hundred per day. You now have us employing a good many extra people, and likewise earning ourselves an extra profit.

We have done exactly this with ham. We have likewise put out canned boiled hams, and smaller packages containing one-third of a ham apiece. We have for many years canned ox tongue for shipment to England, where it is sold sliced by retail meat stores. Now we have added a dog food, Red Heart, in three distinctive flavors of beef, fish, and cheese, and it has become one of the largest selling dog foods in the United States. We are canning Tamales, Mulligan Stew, Beef'n'Vegetable Dinner. We are bearing down more heavily each month with our specialties, and are building this volume of business to higher figures.

Profits and Employment

Selfishly, we are taking a substantial share of our total profit from these specialties, though it will doubtless be a long while before anything supplants the staples as the mainstay of our business.

What is really more important, the specialties are bringing into our organization for steady employment large numbers of people who would otherwise be on the relief rolls. Until the shortage of livestock induced by drought and governmental control combined to shut off a large proportion of our raw material supply, we were employing more people than ever before.

Even now, with the supply of animals for slaughter running far below where we should like to see it, we are employing a great many more people than we did back in the days when our tonnage was no larger than it is right now. And this despite the fact that we have taken advantage of every feasible production economy and technical advance, as we must to assure giving value to consumers and thus to continue to grow to assure our people steady employment.

The differential, all to the good from the dual standpoints of net profits and employment, may be properly attributed to the development of specialty lines.

Bacon slicing and packing at John Morrell & Company's Sioux Falls, S. D., plant

A Cost-per-Task Wage Plan

Concluding article on cost-per-task plan of controlling labor costs, with special reference to use as wage payment method

PHILIP BERNSTEIN
Time Study Engineer and Job Analyst
Winchester Repeating Arms Company, New Haven

AS A METHOD of wage payment, the cost-per-task plan* makes for uniformity. To the shop employee, it is still like piecework or any other method where the employee is paid directly in proportion to his output.

To install this method, every type of operation has a separate card. In the left-hand column, the name of the component is typed; in the middle column, the task; in the right-hand column, the cost per task, which will be identical originally for all the components on this card. When a change in method of operating on any one or more components is made, only the cost-per-task value is changed, and that in proportion to the change in output per hour for the operation. For example, a typical card in the Bullet Shop might look like Figure 1. Costs are fictitious, of course.

You will notice that on the 30 Eagle there has been a revision in output from 25 to 37.5 M per hour with a consequent revision in cost per task from \$0.50 to \$0.333. Note that we don't say a revision in the task, because the task always remains at 25 M for cost purposes.

Card for Each Operation

For each type of operation, the clerk has a similar card, with the cost varying from \$0.35 to \$0.40 for females and from \$0.50 to \$1 for males, depending on the degree of skill and strength required. For instance, a machine operation such as drilling or power milling would have an original cost per task of \$0.50 at the present time. A screw machine hand would have a \$0.55 cost per task; a brass caster, \$0.75; a drop forger, \$0.90.

Now, if an emergency arises, where all the rates in a plant must be changed either up or down, all the clerk need do is change her cost-per-task values on her cards by the specified percentage. This is a matter of a few hours' work, because one shop has only three or four different cost-per-task values. Compare this with blanket piece rate changes, where days are consumed in changing cards and files.

Getting Labor Cost

A typical operative's time ticket is shown in Figure 2. Where the clerk records output and hours, she next looks on the R. F. Swaging card, and finds component 22 L.R. Opposite this she finds the task of 50 M. Dividing output by 50 M gives 8.5 tasks. She also records \$0.50 as cost per task, and the product of tasks by cost per task is the labor cost. If the labor cost is greater than the operative's day rate, no retainer is paid. If labor cost is less than guaranteed day rate, retainer is added to labor cost, making total cost equal to guaranteed day rate.

Now suppose we start to swage a component that has not been previously swaged. The ticket would be similar, except that the tasks would be recorded in the "no credit tasks" box. When all the tickets have been made out and extended, the clerk then totals all tasks, direct labor, retainer, indirect labor, and excess labor, such as repairs, reworks, etc. Dividing these various costs by number of tasks gives cost per task for each account.

C. F. SWAGING

Component	Task	Cost per Task
22 Wing	30 M	\$0.50
25/20 Crow	27.8	0.50
30 Eagle	25 (37.5)	(0.50) 0.333
303 Wing	27.8	0.50
351 Crow	25	0.50
38 Arrow	25	0.50
38 Dart	25	0.50

Figure 1

These data are summarized on another ticket and sent along with the time tickets to the cost department, where the payroll is made up from them. Payroll clerks do not need to duplicate or check the shop clerk's work, except for an occasional spot check by the cost department. In totaling daily tasks, the no-credit are not included, as they are not original tasks and show an increase in the account, direct labor cost per task.

If direct labor cost per task increases, we know that operations are being added for some reason or higher class help is being employed —or *vice versa* if cost per task shows a decrease. Increase or decrease in the quality of a product will also be similarly reflected.

When Methods Change

If an entirely new method of processing a product is introduced, we must still keep the original tasks to show a comparison of the cost per task by old and new methods. Extreme care must be taken to avoid errors, as the operations may not resemble each other. Let's take a fictitious example:

Old Method		
Operation	Task	Cost per Task
Mill	200	\$0.50
Drill.....	250	0.50
New Method		
Blank and Pierce.....	111 (700)	(0.35) 0.0555

In the new method we must still credit the operative with the equivalent tasks for milling and drilling, which is 111, although her output is now 700 per hour. The cost per task is reduced in proportion to the increase in output from 111 to 700 and also in proportion to the reduction from \$0.50 to \$0.35 from male to female, making the actual new cost per task \$0.0555.

*See "Cost per Task," August, page 339.

NAME John Doe #DKB1000
COMP. 22 L.R. DATE 4-1-35
OPER. Swage
ISSUED 8:00 A.M. RETURNED 5:00 P.M.

Output	Hrs.	Tasks	No Credit Tasks	Cost per Task	Labor Cost	Retainer to Day Rate	Total Cost
425000	8	8.5		0.50	4.25		

Figure 2

In group operations one must also exercise care. Suppose originally a group of four performed a series of operations, and changes were made so that three could do them. Each of the three must still receive credit for the tasks of the fourth, and for a shortcut the original tasks can now be reduced by 25 per cent to make up for the elimination of one of the group. Cost per task will also show a 25 per cent reduction.

In a shop paid entirely by daywork, tasks may be set in the same way as for any other wage plan. Tasks can be totaled each day and labor cost per task had by dividing labor cost by tasks performed.

This will not be so uniform as the plan of paying direct labor by cost per task. Paying by cost per task gives a constant direct labor cost per task so long as the product, processes, and class of help remain the same. When any one of these three factors changes, direct labor cost per task reflects the change immediately. Even the absence of an experienced employee will be reflected in a decrease in number of tasks and a consequent increase in total cost per task.

If Supervision Is Alert

In the straight daywork plan, however, increase in output without consequent increase in direct labor cost will be reflected in a lower labor cost per task. However, this is not likely to happen unless there is another form of incentive to take the place of piecework, or when alert supervision makes job retention the incentive.

It will be noticed that cost of tools and number of tasks go hand in hand. Breakage of tools interferes with output, making for fewer tasks, and consequently higher tool and total cost per task.

As far as cost books are concerned, they can be set up by cost per task also. A page would look somewhat like Figure 3.

To this is added the cost of material per 100 units and, if wanted, the material cost per task. In the same way the burden accounts can be added and a manufacturing cost per task obtained, as well as a cost per 100 units. To reduce costs, the number of tasks per unit must be diminished by new equipment, changes in manufacture, etc. When there is a choice of manufacturing in either of two shops, a glance at the labor costs per task for each shop will show immediately which of the two is the more economical for manufacturing the unit concerned.

Monthly cost sheets can now show the accounts in costs and costs per task, compared with the corresponding month of the preceding year. It is then a simple matter for foremen to notice from these sheets whether or not their respective shops are improving. Again, I say, here is the answer to the foreman's query as to whether or not he is worth a raise.

Each week the tasks and costs for each shop in a division can be totaled and the divisional cost per task determined. For a non-production shop in a production division, no tasks are credited, but the costs are figured in the divisional costs. To find the non-production shop's cost per task, we divide its costs by the tasks for the entire division, or by the tasks of the shops it services.

Now the tasks for each division can be totaled and also the costs. Dividing costs by tasks gives the plant cost per task. Non-production divisions are not credited with any tasks, and cost per task for these divisions is obtained by dividing their costs by the plant tasks, for such divisions as power, maintenance, and the like.

Now that we know what the plant cost per task is, we can find monthly sales value per task, deduct administration, selling, and returned goods cost per task, and then find operating profit per task, so that ultimately we know what profit to expect per task if the cross-section of work in the factory is of a certain make-up —or, better still, we know what profit or loss to expect per task for each division.

Operations	Task	Tasks per 100 Units	Cost per Task	Cost per 100 Units
Forge	40	2.50	$0.90	$2.25
Drill	250	0.40	0.50	0.20
Mill	200	0.50	0.50	0.25
File	50	2.00	0.55	1.10
Inspect	100	1.00	0.35	0.35
	Total	6.40	$0.649	$4.15

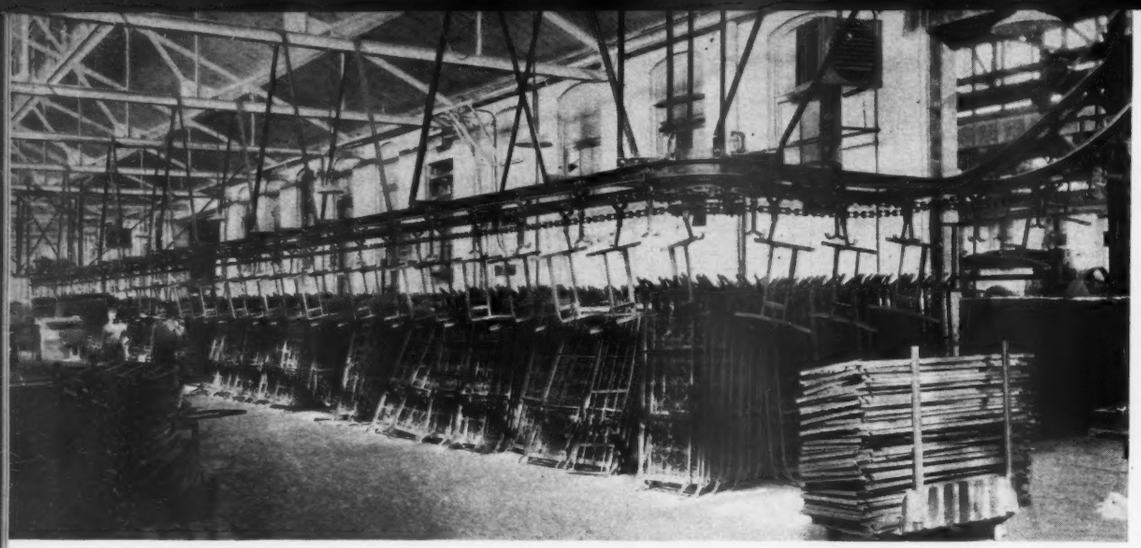
Figure 3

For budgetary control, when we know the monthly schedules for the various shops, we can break them down into tasks, and then determine what payroll and outside purchases will be necessary. For instance, we can determine what grinding wheel cost per task has been, what lubricants, abrasives, etc., cost per task has been, and therefore we know exactly how much money will be required to run each division and the entire plant.

Cost-per-Task Estimates

In estimating for outside customers or even for new products, the cost-per-task plan can be used. To start with, a tentative list of operations is made up, and tasks for

(Continued on advertising page 61)



It's a long, long way from paint drying oven to packing room at J. R. Bunting Company, Philadelphia, but glider parts make the trip quickly and economically via overhead trolley conveyor

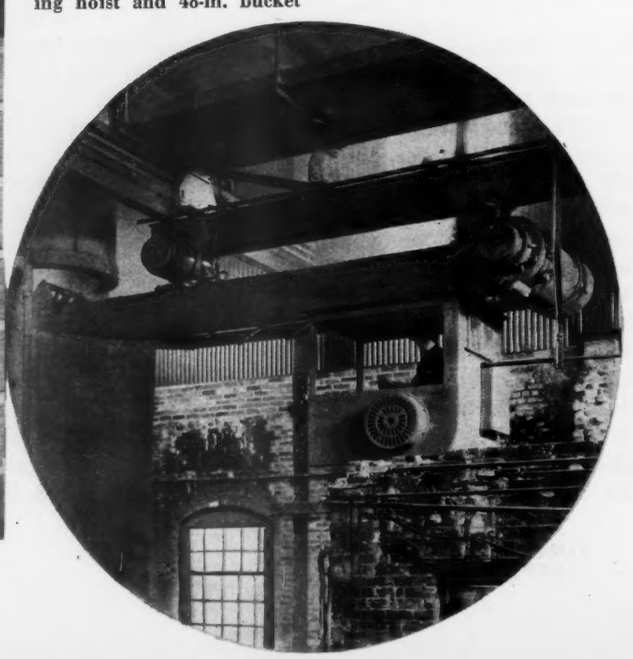
Move It—at Low Cost

Whatever your product, modern methods can almost always save you some of your handling costs

Gas locomotive at Auto Specialties Manufacturing Company, St. Joseph, Mich., hauls foundry sand from lake shore three-eighths of a mile away

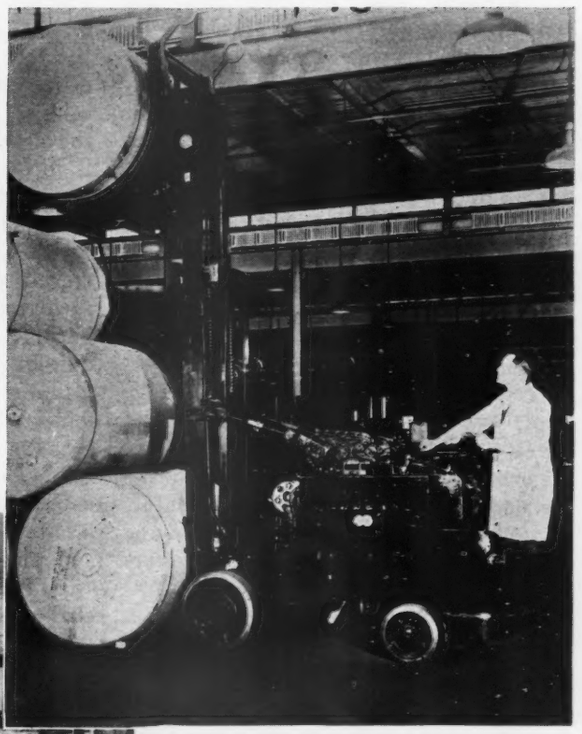
Warehousing tinplate by tiering to the floor load limit with electric truck. Instead of pallets, light wooden strips are inserted between the bundles to allow entrance and removal of truck forks

Cupola charging installation at Crompton & Knowles Loom Works, Worcester, consists of 3-ton transfer crane equipped with charging hoist and 48-in. bucket

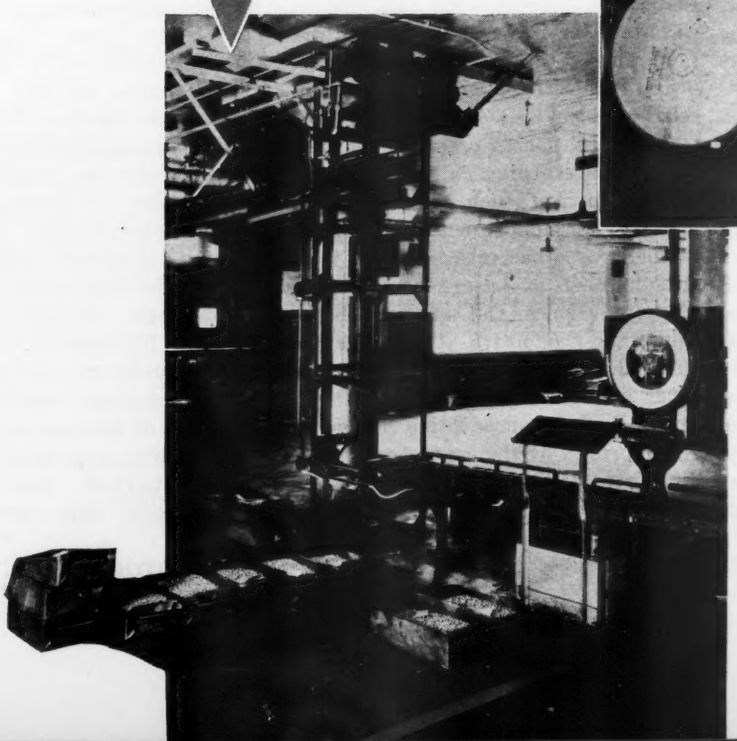


Parts and products are handled through enameling processes at Edison Electric Appliance Company, Chicago, over this extensive monorail system

When loads are heavy, and hauls are frequent and short, there are hand lift truck and skid platforms. Here they're in use in a metal-working plant



One good way to handle rolls of paper. This special roll handler is capable of stacking 2,800-lb. rolls four high. It can negotiate box cars, either to load or unload, and by means of its tiering mechanism can utilize the storage space up around the roof



Vertical hoist teamed with roller conveyor cuts handling costs in manufacture of ball bearings. Here the tote boxes are weighed, automatically elevated, and discharged onto a gravity conveyor

We Centralized Typing

Second half of an article describing nine steps in organizing a department that produces better work at 60 per cent less cost

MARY L. LITTLE
Supervisor, Bausch & Lomb Optical Company
Rochester, N. Y.

AN AUGUST article (page 342) told how the department was set up, including details of service, personnel, bonus system, physical layout, and ways of economizing. The rest of the story concerns equipment and records.

7. **Equipment.** No department can operate efficiently unless its equipment is modern and in good working order. Dictaphones and typewriters must be kept clean and in perfect mechanical order. Equipment with the simplest mechanism, greatest ease of operation, and greatest durability is essential in a stenographic department. Replacement of worn-out machinery should be made without delay, for the cost of keeping it in use will be reflected in production and quality.

Innovations in office equipment are appearing constantly on the market. The stenographic supervisor should investigate all new equipment that may provide the means of economy in the department.

8. **Production Records.** We have found that adequate records are of great importance to the satisfactory operation of the stenographic department, and for providing information to other departments on the activities of their personnel in letter-writing.

A. Incoming jobs, broken down into types and classes, as follows:

a. Dictaphone cylinders are recorded, and the slips marked with date and time of receipt. Each cylinder marked "Rush" is recorded, also the number of letters on each cylinder that are of a rush nature. At the end of each day this information is transferred to a monthly sheet showing names of all dictators, number of cylinders dictated in the morning and afternoon of each day, and number of "Rush" letters received. The actual number of letters dictated should follow the number of cylinders dictated, for this information is of much greater value than the cylinder information.

These records of incoming work are used to show the department heads each month the exact number of letters dictated by their personnel, when the dictation peak was reached during the week, the time of dictation during the day, and the amount of "Rush" work each dictator sent to the stenographic department.

b. All miscellaneous copy jobs are recorded on simple mimeographed "Instructions," showing number of job, or the order in which the jobs are received and should be delivered; date received; person receiving job; person sending job to the department, and where delivery is to be made; type of job, whether form letters, copy work (typewritten or handwritten), envelopes, fill-ins (with or without salutations), stencils, notifications, or other forms; any special instructions regarding set-up; number of copies required; delivery promise date; actual delivery date, and to whom delivered; and name of operator performing the job, with job classification. These instruction forms save errors in interpretation and give an accurate record of the job for future reference.

BAUSCH & LOMB OPTICAL CO.

STENOGRAPHIC DEPARTMENT
INSTRUCTIONS FOR COPY AND FORM WORK

Job Number 174 Date Received 5-23-35
Received by E. Dale

Received from Specialty Sales
(If delivery is to be made to other than the person or department from which the work is received, so indicate Bindery

TYPE OF JOB: (Check)

Form Letters _____ Form Number _____

Copy Work (Longhand) _____
(Typewritten) _____

Envelopes V Kind 391-C

Fill-Ins V (With Salutation) V
(Without ") _____

Stencils V Straight Copy V
Tabulation _____
Listings of Names _____

Notifications _____

Catalog Specifications _____

SPECIAL INSTRUCTIONS Stencils for letterhead to be signed by J. F. Brandt. Date May 23 1935 Address envelopes from list herewith

Number of Copies 276 Set-up _____

DELIVERY PROMISE (Date) 5-23-35

JOB DELIVERED (Date) 5-23-35 To Bindery

OPERATOR'S NAME C. A. Diehl Job Class G

Simple mimeographed "Instructions" accompany all copy jobs, save errors, provide records

B. Production figures, which include:

a. Work sheets prepared by each operator, recording daily the cyclometer points of each job completed, whether dictaphone work, copy work, stencils or other miscellaneous jobs, the number of letters or pages of copy, envelopes, and any miscellaneous non-productive time due to breakdowns of equipment or delays over which the operator has no control. Such non-productive time must be approved by the supervisor before it is reported on the work sheet.

b. Daily summary records of departmental production, showing dictaphone letters transcribed, cyclometer points typed (transposed into lines), number of cylinders transcribed, pages of copy work typed, cyclometer points of copy work typed (transposed into lines), envelopes addressed, headings filled in, and number of hours worked, including absenteeism. Absenteeism in our department averages 1 per cent of the total working time.

c. Weekly records, summarizing the daily information.

d. Monthly records, compiled for a report to the management of the activities of the department.

e. Yearly production reports, including payrolls and letter costs. Letter costs have decreased from

BAUSCH & LOMB OPTICAL CO.

Date

OPERATOR	Dictaphone Letters Written	Dictaphone Cyclometer Points	Cylinders Trans.	Copy Work Pages	Copy Work Cyclometer Points	Copy Work Envelopes	Fill-Ins	Day Work		Dictation Time		Hours Worked		Absences		Repairs		Dispensary	
TOTALS																			
Average Letters per Operator								Cylinders Left											
Average Lines per Operator																			

Daily summaries of department production are made on this form

12.5 to 5c. since the organization of the department. We attribute this reduction to centralization of functions, the dictating machine system, standardization of forms, and the increase in production through the bonus system.

9. **Stenographic Manual.** A manual of information for stenographers, dictating machine operators, typists and other clerical workers holds an important position in our office system. This manual contains the following:

A specimen of the style of letter-writing used by our company, with instructions for setting up such a letter.

Listing of the printed forms commonly used, and when and how to use them.

Information regarding incoming and outgoing mail deliveries.

Disposition of correspondence—a description of the functions of the general filing system.

Care of equipment.

Simple rules for capitalization and punctuation.

A listing of accepted abbreviations, signs and symbols.

Division of responsibility in our offices.

List of domestic and foreign branches of the company, travelling salesmen, and principal domestic and foreign dealers.

Sales classifications and trade classes.

Alphabetical listing of product names.

A list of technical and scientific terms common to our industry, and their simple definitions.

The information in this manual is kept up-to-date by the stenographic supervisor.

Name _____ Date _____

POINTS

CYCLOMETER READING

Dictator	Start	Finish	Letters	Envelopes	Fill-Ins

Daily work sheet filled in by each operator provides a record of the day's production

Additional Functions

In order that the stenographic department may give a complete service to the company, we have found it desirable to centralize other functions there. One of these functions is the routing of copies of letters to salesmen in the field. Another function is the checking of dictated letters for composition and promptness of reply to customers' inquiries. Weakness in composition, whether in sales attitude, clarity or adequacy of information, are brought to the attention of department heads and division managers. This check, with the subsequent interviews with correspondents and letter-writing suggestions, has shown the company a definite improvement in composition and a decrease in the time taken for replies to inquiries, whereby the number held more than two days before the reply was dictated has dropped from 7 per cent of the total to 3 per cent, over the three years that have now elapsed since the centralized stenographic department was originally organized.

Borrowing for Profit

More examples of industry's loans from FHA, Federal Reserve, and RFC. New equipment, new layouts mean new profit

THREE great national agencies still have funds to lend industry to enable it to modernize and operate for profit.

Federal Reserve bank loans for working capital, under which equipment may be included, are available in any amount for periods up to five years. Interest is at prevailing rate in district. Made through your local bank or direct with district Federal Reserve bank.

FHA will insure loans up to $50,000 made by local banks for modernization and new machinery. Loans are repaid in equal monthly installments over a period of not more than five years. Interest rate is equivalent of $5 discount for $100 face amount of a one-year note payable in monthly installments.

RFC with its maximum amount set at $500,000 makes loans for equipment, rehabilitation, construction, and payment of debts and taxes. Loans are obtained direct after refusal by local banks, or RFC may participate with bank up to 80 per cent of the loan. Interest rate is five per cent; loans must be amortized in ten years if made for capital expenditure, otherwise in five.

Loans for Working Capital

Here are examples of loans made or underwritten by the Government:

A loan of $100,000 was made to a manufacturer of refrigerated containers for use in preserving perishable foods. The company needed funds for wages, salaries, and the purchase of materials. Outlook was favorable and a 50 per cent increase in operations was in prospect. Certain creditors were willing to subordinate their claims, and local banks were willing to participate in a loan. Installment accounts receivable were offered as collateral.

Another concern, manufacturing metal cabinets and ice refrigerators in a northwestern state, needed $60,000 more than the local banks could advance. A loan for $40,000 was obtained from one of the national agencies, secured by a first mortgage on plant properties. Local citizens and the concern's employees then subscribed and paid for $20,000 of debentures to complete the needed working capital. Payment of the debentures is deferred until the federal loan has been fully paid.

This Concern Got Two Loans

Still another concern whose factory is the principal manufacturing plant in a northwestern town needed working capital to carry on its manufacture of children's furniture and toys. Upon agreement by creditors to subordinate their claims a loan of $40,000 was made, secured by a first mortgage on properties, pledge of accounts receivable, officers' guarantee, and assignment of life insurance. The loan was paid off in a short time. Later application was made for a new loan of $60,000 on the same basis as the first. This time a local bank indicated willingness to participate for 20 per cent, which participation was granted.

A father and two sons operate a small plant devoted to marine engineering, boat building, and the handling of marine hardware to serve the requirements of river trade in the Middle West. With a local bank participating, a loan of $4,500 was made to finance construction on hand.

Thousands for Modernization

One brewing company received $50,000 for plant repairs, and another brewer obtained a like amount for new layout, equipment, and modernization. A machine tool manufacturer got $48,000 to modernize his factory while a realty company used $26,630 to do the same thing for a factory that it was operating. A concern making steel products applied for and was granted $16,000 for modernization, and a grower and packer of mushrooms received $15,000 to bring his plant up to date.

Proof that investment in modernization and new equipment does pay has been repeatedly shown in FACTORY articles. *Took $400,000 Plunge* in July and *Where the $400,000 Went* in August told the story of John Morrell & Company, Ottumwa, Iowa. This meat packing firm invested in a new building and new equipment right in the midst of depression. Opportunity to decrease costs through use of late developments in materials handling equipment and building materials, thereby cutting down labor and maintenance expenditures, prompted the venture. Result — production costs went down, production went up, employment up. Savings on production made possible expanded promotional efforts, and the company attributes its ability to make a profit all through depression years to this venture that took advantage of technological improvements.

Packard Spent $6,200,000

Packard Motor Car Company, Detroit, ventured the expenditure of $6,200,000 for new equipment and its installation in a portion of its factory left vacant by improved layouts in the rest of the plant. *Problem: Too Much Plant* (January FACTORY) told two stories of Packard investment for profit. Money spent to revamp the old production line cut production costs, and the large investment in up-to-the-minute equipment made possible manufacture of a new line of cars to sell in a lower price class.

An investment prompted by increased output gave Globe-Union Manufacturing Company, Memphis, Tenn., increased plant capacity (see *New Equipment—New Layout—20 Per Cent More Capacity*, FACTORY, November, 1934). Necessary new equipment and consequent new layout gave an increased capacity which spelled dollars and cents for the company.

Cost, Health, and Safety Said "Conveyorize" (June, 1934) told of complete conveyor installation in the plant of the Solar Corporation, Milwaukee. Production was speeded up with consequent reduction of costs. In addition, safety was enhanced.

If you need new equipment and want to modernize, now's the time.

Put Costs Up to the Foreman

Thoroughly effective control of plant expense begins right at the source of expenditure—that is, with the foreman

FRANK KLEIN
Director of Budgets
Worthington Pump & Machinery Corporation
Vice-President, New York Chapter
National Association of Cost Accountants

ONE of the most interesting developments of progressive industrial management in recent years has been the rapid transition of the shop foreman. Beginning as a gang boss, with rule-of-thumb methods, his duties consisted of little else than getting out production. Later, when piece and wage rates were introduced, he came into contact with his first records calculated to measure the value of his workers' output. But only in recent years, with the development of cost and expense budgets, has the foreman emerged as a business manager of his department, interested not only in production, but also in the financial result from that production.

In the great majority of cases in which foremen have been given responsibility for the financial results of their departments, they have not only accepted it, but have also welcomed this additional confidence that management has accorded them. It is therefore reasonable to state that in those organizations where the shop foreman is not accurately and properly controlling his costs of doing business, it is not his fault, but that of management for failing to recognize his potential abilities, and for neglecting to furnish him with the necessary tools for such control.

When Volumes Fluctuate

A most difficult phase of industrial operations to control is that of plant expenses in periods when volumes are fluctuating. In job or special-order businesses this fluctuation is almost continuous, and the consequent problem of expense variation is especially acute. This is due to the fact that some expenses, like core sand, machine power, and certain contributory labor may vary directly with the volume of production, whereas other expenses, such as shop supervision, clerical, oiling, and cleaning labor, and some maintenance and supply items vary to a lesser degree when output changes; still other expenses, such as heat, taxes, insurance, and watchmen are fixed regardless of output.

▼

Controlling plant expense through foremen is successful because it places responsibility where it belongs, gives foremen greater vision of their duties, utilizes the ingenuity of each foreman in stopping the many small leaks through which profits are dissipated. In those organizations where it is properly administered it has survived the drastic curtailment of other plant routines and procedures during the past few years of depression, and is helping management to a more profitable basis of operations

▲

Much has been written on the subjects of expense distribution, burden rates, and allocation of overhead. They are all of interest to the industrial accountant in costing the product, and are sometimes used in an attempt to measure the department's efficiency in controlling expense. But is it not apparent that the only effective way to control plant expense is to control it at the source of expenditure, before or at the time it is to be incurred? Is it not logical that every foreman or supervisor who has the authority to requisition and use the company's materials, labor, and other services should be furnished with a guide to the proper amounts of the various expenses that may be incurred for the volume of work he is producing? And is it not good management to make each foreman responsible for his individual performance through a comparison of his actual results with the predetermined standards?

The plan by which such control is accomplished must be simple, direct, and inexpensive to operate. In its simplest form an expense control need only provide for:

1. A measure of the volume of work being produced by the department—in tons, yards, pieces, or productive hours.
2. A study of each class of expense essential to the operation of the department, and the degree to which each class of expense should vary with volume of output.
3. A regular and systematic comparison of actual expense with the standards for the volumes produced, and the necessary follow-up with the foreman for corrective action.

A more detailed discussion of each of these provisions will show that their application can be adjusted to meet the needs of any industrial organization, and that their simplicity of operation makes them available equally to the large or small manufacturing business.

Measuring the Output

Every department in an operating plant has a definite function in the production of the output—either it is directly processing the product, or it is rendering a service to the producing departments. As income is measured by the quantity of output, every productive department's expense must be measured by its volume of productive work, and every

WORTHINGTON PUMP AND MACHINERY CORPORATION

WORKS INDIRECT EXPENSE BUDGETS PER WEEK FOR VARIOUS OPERATING CAPACITIES

Y ____ WORKS

Z ____ DEPT.

REVISED ____ 1 ____ WEEKS ____ Brown ____ FOREMAN

	DIRECT HOURS	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
NO.	PER CENT CAPACITY	50	55	60	65	70	75	80	85	90	95	100
01	Executive Staff											
02	Foremen	35	35	35	35	35	45	45	45	45	45	45
03	Inspectors											
04	Clerical	27	27	28	28	29	29	30	30	31	31	32
	Total Superv. & Cler.	62	62	63	63	64	74	75	75	76	76	77
10	Guards & Gatemen											
11	Oilers, Sweep. and Clean.	10	11	12	13	14	15	16	17	18	19	20
12	Internal Transportation	7	7	7	8	8	8	9	9	9	10	10
13	Personnel Adjustments											
14	Idle or Lost Time											
15	Other Indirect Labor	35	38	41	44	47	50	53	56	59	62	65
	Total Indirect Labor	52	56	60	65	69	73	78	82	86	91	95
20	Fuel											
21	Sand											
22	Nails, Rods and Wires											
23	Binders and Facings											
24	Grinding & Polishing Wheels	4	4	5	5	6	6	7	7	8	8	9
25	Paints, Lubricants & Waste	5	5	5	6	6	6	7	7	7	8	8
26	Stationery & Office Supplies	1	1	1	1	1	1	2	2	2	2	2
27	Miscellaneous Supplies	5	5	5	5	5	5	5	6	6	6	6
28	Purchased Electricity											
	Total Operating Supplies	15	15	16	17	18	18	21	22	23	24	25
40	Real Estate											
41	Buildings											
42	Machinery	30	33	36	39	42	45	48	51	54	57	60
43	Motors	6	7	7	8	8	9	9	10	10	11	11
44	Semi-durable Tools & Inst.	90	99	108	117	126	135	144	153	162	171	180
45	Internal Transp. Equip't											
46	Carting Equipment											
47	Furniture and Office Appl.											
48	Flask Equipment											
49	Patterns											
50	Miscellaneous Equipment	4	4	4	4	4	4	4	4	4	4	4
	Total Maintenance	130	143	155	168	180	193	205	218	230	243	255
60	Re-arrangement of Equip't											
61	Postage											
62	Telephone											
63	Telegraph and Cable											
64	Inventory Adjustment											
65	Employees' Welfare	2	2	2	2	3	3	3	3	3	3	3
66	Liability Insurance											
67	Dues and Subscriptions											
68	Gratuities											
69	Rentals											
70												
71	Miscellaneous Expense	4	4	4	4	4	4	4	5	5	5	5
	Total Sundries	6	6	6	6	7	7	7	8	8	8	8
	Total Above Charges	265	282	300	319	338	365	386	405	423	442	460
80	Depreciation											
81	Insurance											
82	Taxes											
	Total Fixed Charges											
	Total all Charges											

service department's expense must be related to the productive department for which the service is performed. In other words, the productive department should spend only as it produces, and the service departments should render service to such productive departments only on the basis of the output by these productive departments.

Is is essential, then, that the activity of each productive department be measured by some reliable means, so that its proper allowances of expenses may be made. If the production is a continuous process, such as the smelting of iron or steel for ingots, the unit of output is naturally the tonnage produced. If castings of a uniform nature are produced, then the output will be stated in number of castings produced. If the department's output is not of a uniform nature, but consists of producing job pieces to special order, it will be necessary to select some uniform basis of measurement of output, such as the direct man-hour or the standard unit-hour.

After the proper basis for measuring output (such as tons, pieces, or hours) has been selected the next step is to determine the total possible output of such units in the normal working week. If, for instance, the equipment, when employed the full 40 working hours a week, can produce 1,000 tons of melt, then 1,000 tons would represent 100 per cent output or capacity. Aside from the use for expense control purposes, it is desirable for management to have these additional data, so that it may know just what portion of its facilities is being engaged currently in productive work.

For example, 400 tons of actual production in a week indicates that only 40 per cent of the possible 1,000 tons production was secured. Similarly, in a machine shop department with 50 machines at 40 hours per week, 2,000 direct machine-hours are possible. If only 1,200 hours were actually worked, it would indicate that only 60 per cent of the possible use of those facilities was obtained. This information is useful alike to the shop management and to the sales division.

Allowing Expense for Output

Now that the foreman knows what his department is capable of producing, the next step is to learn what should be the expense cost of such production. This can be done in various ways, but for this purpose one simple example will be assumed:

Take the machine-shop department mentioned above, where 50 machines working the normal week of 40 hours can produce 2,000 productive hours. What should be the expense cost for any rate of production?

First step will be to ascertain present rate of operations. Assume that approximately 1,500 productive hours are being worked currently per week, representing an actual operating rate of 75 per cent of the total possible 2,000 hours.

Second step will be to review with the foreman every indirect worker, item of supply and maintenance, and other service work required by his department at the present rate of operations. A careful study, in cooperation with possibly a plant industrial engineer, maintenance foreman, or other employees, may reveal unnecessary current expense which may be eliminated before listing the remaining expenses as essential to the production of 1,500 productive hours per week.

Third step—important but sometimes not provided by some organizations—will be to determine the extent to which each of the listed expenses should increase or decrease as production varies from the assumed starting point of 1,500 hours. By means of a sheet with as many columns as it is desired to divide the operating volumes into, a separate listing of the essential expenses

(Continued on advertising page 68)

To Negligence: $10,000

Up-to-date equipment would have protected this concern against a judgment for exemplary damages

LESLIE CHILDS
Attorney and Counselor at Law
Indianapolis

THE MEASURE of an employer's liability for injury to an employee, caused by defective machinery, may depend upon the character of the default. Ordinarily, the liability will be limited to an amount sufficient to compensate the injured person.

On the other hand, in some jurisdictions the doctrine of exemplary damages flourishes like a green bay tree, and here, if convicted of continuing gross negligence, an employer may expose himself to damages in the nature of a punishment over and above those assessed as compensatory, for the purpose of making an example of the employer.

When Tempted to Put Off

Here is a point of law that may well give pause to employers, when tempted to put off the making of needed repairs and replacements.

A manufacturing company, it appears, neglected over a long period of time to repair or replace a badly worn motor-driven machine. As the result, an employee was shocked and killed while operating it.

The company carried workmen's compensation insurance, and the plaintiffs, dependents of the deceased employee, were paid statutory amount thereunder — namely, $3,674.16. The plaintiffs then brought action for exemplary damages, on the grounds of the company's gross and continuing negligence in furnishing the defective machine. Quoting from the opinion, the evidence of negligence may be summarized as follows:

"At the time (the employee) was killed, the machine had been in use several years, was worn, had developed considerable vibration, and in damp weather would become so charged with electricity as to shock and sting on being touched. The cable had been in use since 1926, its insulation in places had become worn, and several weeks prior to the accident the rubber casing at the point where it entered the machine caught fire and burned. . .

"The evidence justifies the conclusion that, on reasonable inspection by one possessing knowledge of electricity, the condition of the cable, its insulation, the coils of the motor, and the machine, would have been disclosed, but that such inspection was not given. The levers could have been handled with safety had they been properly insulated, or the machine could have been equipped with grass rope instead of metal levers, and operated with safety. There was no device in use to indicate when the machine was charged, or to automatically stop its operation when in such condition, although such devices could have been installed. . .

"The plain facts are that for years the company provided for the use of its employees a dangerous machine; and although the infirmities increased with use and age, efforts to render it safe, if any were

made, were but of the slightest character. . ."

On the above facts, the trial resulted in a judgment in favor of the plaintiffs for $10,000. The company appealed, which raised the question of the sufficiency of the evidence to sustain the judgments for exemplary damages. In reasoning on this, and in affirming the judgments, the higher court said:

"We, of course, subscribe to the doctrine that a corporation usually cannot be held liable in exemplary damages for the gross negligence of its ordinary employees performing ordinary delegable duties. But we have no such case before us. The duty of a master to exercise ordinary care to provide his servants with reasonably safe appliances and instrumentalities with which to perform their duties, is an absolute and continuing duty, and cannot be delegated in such a way as to relieve the master from liability.

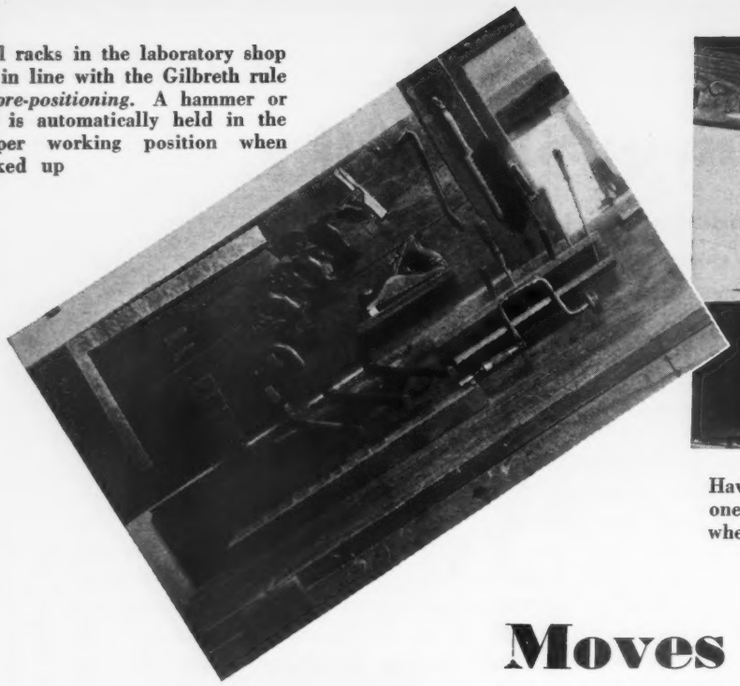
The Court Reasons

"It was the non-delegable or absolute duty of the company in this case to exercise ordinary care to provide (the employee) with a reasonably safe machine with which to do his work, and by inspection and repair to keep it in that condition. . . Not only was it the non-delegable duty of the corporation to inspect and ascertain the condition of the machine, the defects of which caused (the employee) to lose his life, but its superintendent in fact was informed from time to time of the dangerous character of the machine.

"The office of superintendent is ordinarily one of authority and control, and in the instant case his knowledge was plainly the knowledge of the corporation. . . So it matters not whether the gross negligence was that of the superintendent, or some servant, the company remains chargeable . . ." [71 S.W. (2d) 409].

The foregoing case constitutes a fair presentation of the reasoning of the courts that uphold and apply the doctrine of exemplary damages.

In the light of which it is obvious that the continued neglect of industrial equipment that is a potential source of danger to employees may prove a short-sighted policy.



Tool racks in the laboratory shop are in line with the Gilbreth rule of *pre-positioning*. A hammer or saw is automatically held in the proper working position when picked up

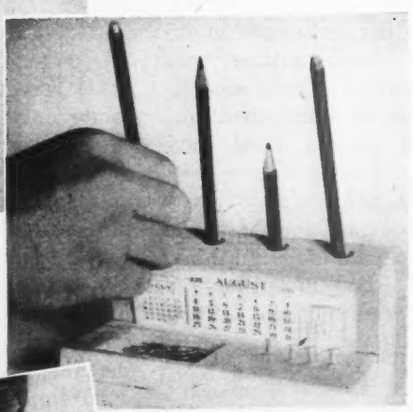
Having tools visible saves time. Ruling pens are inked with one hand, using a special holder which lifts the dropper when the little finger presses at the side of the bottle holder

Moves to Save Motions

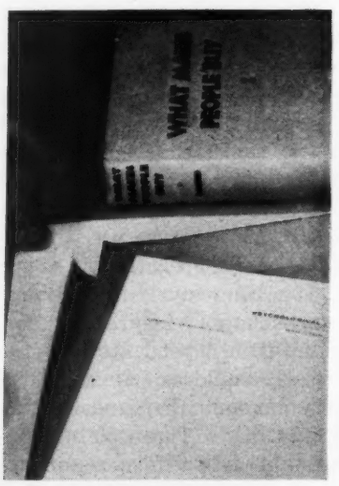
How an applied psychologist applies psychology in his own lab and office

DONALD A. LAIRD, Ph. D.
Industrial Psychologist
Director, Psychological Laboratory
Colgate University
Hamilton, N. Y.

Shaving the proper side of the rubber stamp handle so it is flat for the thumb makes it possible to use it right side up without looking



An adaptation of the Gilbreth pencil rack holds the supply in proper position for instant use. Colored pencils are sharpened at each end. The blue is hexagonal, the red round so the desired color can be had without using the eyes.



Handling carbon paper is simplified by cutting a notch in the upper left-hand corner

Convenience outlets in the laboratory are almost waist high. Appliances can be plugged in without stooping

Laboratory desks are fitted with wooden knobs with long necks so the fingers can be slipped behind the knob without cramping the arm muscles. In one-pedestal desks, the drawers are on the left side, so extra work is done by the hand that is usually idle

What Fatigue Does to Output

What you'd expect and what you actually get are, in a proportion of fatigue studies too large to ignore, entirely different animals

G. J. STEGEMERTEN
Superintendent, Time Study Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

IT IS generally agreed that even under the best conditions workers experience an exhaustion of strength, either physical or mental or both, as the day progresses. This exhaustion is commonly called fatigue, and many interesting attempts have been made to measure it and overcome its effects.

Most, if not all, of the published results of the studies of fatigue have shown that there is a definite reduction of output as the day progresses, and this reduction is attributed to the effects of fatigue. Experiments have been made with rest periods at varying intervals and of varying duration, and here again published results have shown that rest periods were successful in reducing fatigue and increasing output.

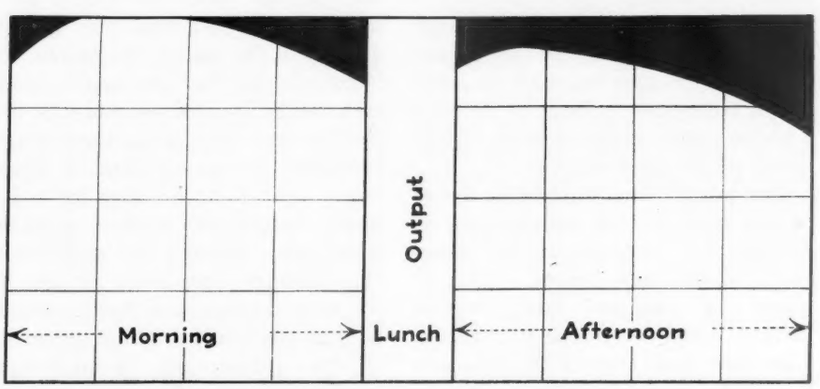
The Other Half of the Story

Without wishing to minimize the importance of the work done in connection with fatigue, I feel that what has been written about it up to the present time presents only half the story. Experience will show that a good proportion of the studies do not indicate the results that analysis would lead us to expect, and this proportion is too large to pass over or ignore.

First, what effect would fatigue normally be expected to have upon output? Analysis and personal experience indicate that output builds up during the first half hour or so of the working day as the worker gets into his stride. At the very start there is quite likely to be a muscular or mental stiffness resulting from the fatigues of the day before, and this stiffness must be worked out before the worker can reach the peak of his productive ability.

When he has once reached his peak he should be able to continue to produce at his maximum rate until he begins to experience exhaustion of his bodily and mental resources. Then his output should begin to decrease, until at the end of the working period it has fallen off appreciably.

In an eight-hour working day divided into two four-hour periods with an interval for lunch, the output of our theoretical worker would be shown graphically by the figure. The curve of afternoon production would be similar in shape to the curve of morning production but somewhat lower because of the fatigue accumulated during the morning from which it was not possible to recuperate entirely during the lunch interval.



Theoretical effect of fatigue upon output—the black area represents loss of output as the morning and afternoon grow older

Analysis then indicates the relation between output and fatigue as shown in the figure. It seems quite logical.

To Determine Lost Output

If this analysis is correct, it should be relatively easy to measure the retarding effect of fatigue. Graphically, the shaded area shows the amount of output that is lost because of the effects of fatigue. To determine quantitatively the output that is lost, it is necessary to take a time study of the worker covering the entire working day. On this study the over-all time for each piece produced should be noted, and all delays and interruptions recorded as foreign operations. The skill of the operator and the effort exerted during the period of peak production should be carefully recorded.

When the study is worked up, productive time for each piece may be found by deducting the time spent on foreign operations from the over-all time. The standard time for doing this particular operation without allowances of any sort should be established by a detailed time study, if it has not already been set. This study can be made during the course of the all-day study by studying a representative number of pieces in detail, or it can be made at some other time.

If the operator observed on the all-day study has been properly rated as to skill and effort at the period of peak production, the net over-all times for doing the job near the beginning of the day, after being leveled in accordance with the leveling method for determining time standards, should correspond closely with the standard time established. That is, when a man for whom a leveling factor of 1.10 has been determined is working on a job that has a standard time of 0.075 hours,

it will be found that his net over-all time for each piece at the period of maximum production will range within a few per cent plus or minus of 0.075 ÷ 1.10, or 0.0682 hour. Expressing this algebraically:

$$\frac{S}{L} = T$$

or

$$TL = S,$$

where

L = leveling factor,
S = standard time per piece,
T = net over-all time per piece.

As the day progresses, the worker will begin to feel the effects of fatigue. His net over-all times will start to increase because fatigue is slowing him up. If a detailed time study were taken, he would receive a lower effort rating, or perhaps skill rating, if he were mentally tired and inclined to blunder, than he did in the morning. If, however, the leveling factor is not changed, the above equation no longer holds true but will become

$$TL - D = S,$$

where D is the amount of time the man is actually slowed up by fatigue.

The time D lost due to fatigue will be an ever-increasing amount as the day progresses, provided our analysis of the effects of fatigue is correct, unless rest periods or change of work lessen these effects. The total amount of time D thus lost during the day may be found from the sum of all of the over-all times O and the number of pieces produced N from the equation

$$OL - D = NS,$$

or

$$D = OL - NS.$$

The amount of time lost due to fatigue expressed in per cent may be found from the equation

$$\left(\frac{OL - NS}{NS}\right) 100 = \text{per cent fatigue factor,}$$

or

$$\left(\frac{OL}{NS} - 1\right) 100 = \text{per cent fatigue factor.}$$

This is a simple and logical method of measuring fatigue if our original asumptions regarding the nature of its effect are correct. Very often by following this method a reasonable fatigue figure will be obtained, and it is a temptation to believe that fatigue has been accurately measured. But the thing that upsets all this theory is that in a great number of cases the results obtained from all studies are not what are expected. Plotted graphically, instead of the smooth curves like those of the figure or even curves that show a general trend, jagged plots are obtained which may show the production peak to be the very first thing in the morning or the very last thing in the afternoon or anywhere in between. Quantitatively, following the above method, unless the production peak is spotted exactly and the skill and effort rating made at that point—a difficult task when it is impossible to know in the morning whether or not the operator will work faster in the afternoon—it is quite possible to arrive at a negative fatigue factor, which of course is valueless.

A 130-Lb. Negro

One would expect to find the most marked effects of fatigue on jobs that are unusually heavy and where great bodily effort is required over a sustained period. Take the job of charging a battery of Swartz oil-fired, open-flame tilting furnaces in a brass foundry. The operation consists of throwing into the mouths of the furnaces ingots weighing 90 pounds each and pieces of scrap varying in weight from a few pounds to 50 or more. The distance between the floor where the ingots and scrap are piled and the furnace mouth is about 6 feet. Each furnace is charged with from 500 to 1,600 pounds of metal at a time; since there are a number of furnaces in the battery, the work is fairly steady. The only relief obtained is in pouring out the melted charge into ladles, skimming the slag off the charge before pouring, and, on some alloys, poling the molten charge with a hickory pole. None of these jobs is light; all of them are hot.

One might think that after a day of this kind of work the charging of the last few furnaces in the afternoon would take longer. Also it would be expected that greater fatigue would be noticed in summer, when the heat around the furnaces is terrific, than in winter. Actually, a long series of studies taken upon this operation revealed no definite fatigue effects. And the most tireless worker in the group performing this operation was not the largest man, but the smallest, a negro 5 feet, 4 inches tall who weighed in the neighborhood of 130 pounds.

Molders Who Ran

Another case in point is in an iron foundry where pouring was done daily about 2 p.m. All molds had to be completed by that time as no molds were made after pouring began. At this foundry, it was the practice to open the plant gates about an hour before the regular starting time. The bench molders were always waiting at the gates. As soon as they were admitted, they began to put up molds. Each mold was made at what would seem to be an excessive pace. It was then necessary to carry the finished mold to the pouring floor, a distance varying from 30 feet in the morning to 10 feet in the afternoon when the floor was filled. The molds weighed about 100 pounds each; the average production of these molders was over 200 molds daily. In carrying the molds to the pouring floor, the molders *ran*, not walked. They set the molds down and returned to their benches on the run. And they kept this up from the time the gates opened until pouring time without stopping even for lunch.

This condition was not the result of supervisory driving. The men were originally brought into the foundry from farms when the foundry first started up. They had never seen a molder work before and therefore had no preconceived ideas of a molding pace. They soon learned the work and discovered that the more they produced the more they earned. Desire for higher earnings did the rest, and they quickly developed the above procedure. It is conceivable that one or two super men might be able to continue this terrific pace for some time before breaking down, or that a group might keep it up at least for a few weeks before the weaker members collapsed. Actually the molders in this foundry have been on the job for several years, and they appear to be none the worse for their strenuous efforts. Incidentally, all-day fatigue studies showed nothing.

Then there was a man working on

heavy drop forgings who seemed unaffected by the heat or the heaviness of his task. And others. Until we are led to the conclusion that heavy work does not always induce great fatigue.

Turning to lighter work, a drill press operator performing a light, routine job always showed a higher production in the afternoon than in the morning. In the morning, he seemed dopey, half asleep, and it was not until after lunch that he seemed to gain full possession of his faculties.

All-day fatigue studies of molders who ran with 100-lb. molds showed nothing

Monotony of work is often supposed by executives and engineers to increase fatigue. And yet there are workers who will object strenuously to change of task, preferring to remain at the work they have been doing for years. Other workers like jobs that change often, where setups are frequent and new problems are continually presented for solution. Studies on either of these types may or may not reveal exhaustion of strength as the day progresses.

Too Many Exceptions

From these observations and many similar ones, it is apparent that fatigue cannot be measured or even observed in all cases. There are too many exceptions even to prove the rule. Undoubtedly there is such a thing as fatigue. At least half of the fatigue studies I have made or reviewed have shown definite fatigue effects, and personal experience would lead anyone to say unhesitatingly that there is such a thing as exhaustion of strength with prolonged effort. But the effect of fatigue upon individuals varies and varies greatly. No two individuals are exactly alike. What one man likes, another despises, and mental attitude undoubtedly influences fatigue to a large extent.

It is not to be expected that executives or engineers worthy of the name would like monotonous work. They have an active type of mind which must continually be wrestling with new problems or they would not occupy their positions. To them, monotonous work would be very fatiguing. But there are other men who shrink from tackling new problems. To think constructively is for them a decided effort. They prefer routine jobs where they can develop a high degree of automaticity; their hands work while their minds are free to think about the subjects most pleasant to them—sports, dances, last night's movie, or nothing at all. If the task is light and no conscious concentration is necessary, a man with this type of mind can probably go through a day's work with little or no fatigue, although the same job might tire a man with a more restless mind to the point of exhaustion.

Workers often find compensations in their work or their surroundings that counterbalance the effects of fatigue. The little negro in the furnace charging group took great pride in his ability to work beside the other larger men and in showing his foreman that he could stand the pace. The satisfaction he derived from this undoubtedly kept away fatigue effects.

Even where workers do show the effects of fatigue, it is safe to say that no two experience exactly the same amount of exhaustion or require exactly the same measures to overcome it. Human beings do not come in standard patterns. Hence it is exceedingly difficult to fix rest periods that will prove beneficial to all workers. Some workers may be rested by enforced rest periods. Others are irritated by being made to stop when they do not feel like it, and this irritation is quite likely to induce greater fatigue than the work itself.

Studies showing that production has been increased by enforced rest periods are inconclusive. It is true that there are cases where this has been accomplished, but it is equally true that production has also been increased by the abolition of rest periods. In other words, in test cases of this kind it is often the effect of change that is being felt and not the effect of the elimination of fatigue, at least by the rest periods themselves, although it is possible that the novelty of the change temporarily stirs the interest of the workers in their surroundings and by so doing relieves fatigue.

Didn't Want Rest Periods

A case in point occurred in an office where it was decided to open all windows for five minutes twice a day to change the air. It was suggested to the office force that they relax during this period and breathe deeply. When the change was first inaugurated, the workers agreed that they all felt better and worked better after the interruption. However, they were a responsible group, loaded with work, and as soon as the stimulation of novelty wore off, they felt that the procedure was only an interruption and an annoyance, and the plan was finally abandoned to the relief of all.

Realizing the variability of human beings, it is well to be suspicious of the results of fatigue studies that are too nearly perfect. Fatigue studies are often made with the full cooperation of the worker. The purpose of the study is explained to him, and the expected results are suggested. If the worker is truly cooperative, it is quite likely that the expected results will be obtained. The worker may not consciously vary his pace to suit the expectations of the observer, but the power of suggestion is

(Continued on advertising page 64)

3,415 Welds

Are 3,415 arguments for making fullest use of modern equipment

ONCE an automobile was assembled by means of nuts and bolts, rivets, nails, and solder. Today its assembly is largely a product of the welder. Latest count on a Ford V-8, for example, shows 3,415 welds—with the number on the increase.

Potent reason for this extension of welding operations in Ford production is the demand for greater strength with less weight. Less weight in turn means less material, lower material costs. Also, most of the welding machines used are automatic, and automatic welding tends to reduce labor costs.

All of which goes a long way toward explaining why it is possible today to produce fast, powerful, durable cars at prices that enable the greatest number of people to buy them. Thus do modern methods and equipment insure wider distribution of better goods. So do they point the nearest way to a lasting recovery.

Much of the equipment used in Ford welding operations is automatically controlled and requires no skill whatever on the part of the operators. All they have to do is put the part to be welded into the machine and then take it out after it has been welded.

All told, 5,000 welding operations are carried on in the Rouge plant. Five standard types of welding are used. Equipment includes more than 1,000 welding torches and over 600 welding machines. An extensive experimental department is operated for the development of transformers.

1 A welding operation on the rear axle housing — wheel flange is automatically welded to a seamless tube

•

2 These big machines weld two 72-in. seams in 7 seconds. There are four such units in the Rouge plant. Each has six 150-kva. transformers, is controlled by a synchronous tube timer

•

3 Gasoline tanks, formerly lockseamed and soldered, are seam-welded. Tank welding machines are now being equipped with "Iron Men"—traveling carriers that move the tanks in a course indicated by the oil marks on the table. The 102-in. seam is welded in 90 seconds, 11 spots to the inch

•

4 Door frame is automatically welded into one solid unit that never squeaks. There are about 50 welding operations on a door. Even the lock is welded to it

•

5 Axle housing seam is automatically welded. Time, pressure, power, quantity of wire, and melting rate are predetermined; personal equation is eliminated

•

6 Flash-welding operation on muffler; welding intake pipe to muffler by butt process

•

OPERATING SHORTS

Shift Schedule for 40-Hour Week

JOHN L. GOOD, *Manager*
The Eagle-Picher Lead Company
Hillsboro, Ill.

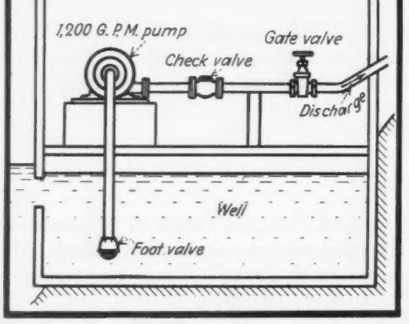
On page 457 of your October, 1934, issue you show a method of handling a 40-hour week for shift men. We believe our method of handling such a shift schedule is superior. It is given below:

Shift	M *	T *	W	T	F	S	S	M *	T *	W	T	F	S	S	M *	T *	W	T	F	S	S	M *	T *	W	T	F	S	S
1	2	2	1	1	1	1	1	1	1	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2	2
2	4	4	2	2	4	4	4	3	3	1	1	3	3	3	2	2	4	4	2	2	2	1	1	3	3	1	1	1
3	3	3	3	3	2	3	2	2	2	2	2	1	2	1	1	1	1	1	4	1	4	4	4	4	4	3	4	3

This method uses four men per single 24-hour cycle with an extra man working two shifts per week, one on Monday and one on Tuesday. Each four weeks the cycle changes. This allows for no one working over 8 hours in any 24-hour period, nor more than 6 days in rotation, nor over 40 hours per week; and we have no short shift changes. It treats everyone alike. It can be worked for any number of men per shift.

We have been using this system for over a year with very good success.

Mr. Good's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.



Blocked Footvalve Prevented Priming of Pump

J. E. WRIGHT, *Montreal, Canada*

Sudden falling off in the water supply of a large plant threatened serious interference with production. Water was supplied from a pump house located on the bank of a river and containing three motor-driven centrifugal pumps.

Investigation showed that a 1,200-g.p.m. pump, driven by a 60-hp., 600-volt motor, was not running. The motor started promptly; so the air vent was opened up and the pump primed.

When water did not appear at the vent, the gate valve was closed, thus relieving the check valve of the head of water in the discharge pipe. The flap was then removed from the valve body. After this had been done the gate valve was opened a few turns so as to prime the pump directly from the discharge pipe. The gate valve was opened slowly as the motor was brought up to speed, and when the compensator was thrown to the running position, the valve was opened wide as quickly as possible. Both pump and motor carried their loads satisfactorily.

The next morning the suction pipe was raised to determine why it had not been possible to prime the pump. Examination disclosed that the foot valve was held open by debris. A 2-ft. snake that had been drawn in through the strainer had become entangled with the debris and had lodged between the foot valve and the casing, thus letting the priming water run out.

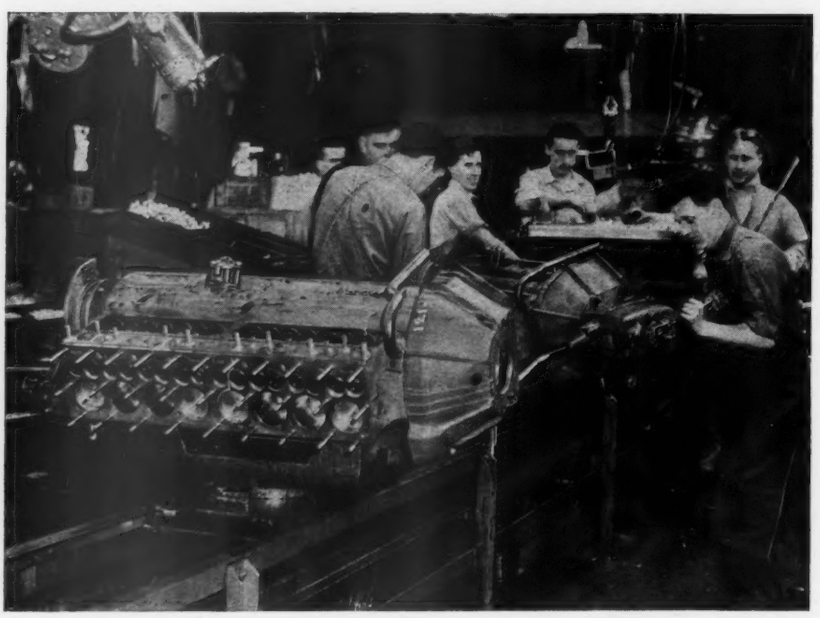
•

Swiveling Work Saves Much Handling

SOURCE, *Packard Motor Car Company Detroit*

An ingenious application of a standard mechanical principle permits more than ordinarily convenient and economical working on the motor block on the motor assembly line at the new "One Twenty" plant. Successive operations on the motor block require access to it from different positions. In the past this has involved a great deal of rehandling, turning over and back again—generally with air or electric hoists.

The way around this difficulty, with its inevitable costs, has been found in mounting the motor block on a swivel block which can be freely moved in either a horizontal or vertical plane. As the block moves along the assembly track, passing from workman to workman, it is easily shifted into working position. Each workman puts it into the position he requires, without either human or further mechanical assistance, and in a fraction of the time required for shifting its position he requires, without either devices lock it in any required position automatically.



Masking-Tape Templets Save Time

R. J. RAHN, *Industrial Engineer*
Dayton

On a recent large layout job I was able to save considerable time by using masking tape for templets. The tape was first stuck to a piece of glass, then templets were drawn on it, lettered, and cut out with a sharp knife. They were then placed on a floor plan and shifted about as desired. When a few templets seemed to be located in the proper positions they were pressed down and stuck to the paper. When it was desired to move them again they were readily removed by inserting a knife blade under one corner. The same templet may be stuck down and removed almost indefinitely without losing its tackiness or injuring the paper.

Among the advantages in using masking tape for templets is the saving in time and the avoidance of blistered fingers from putting in and removing pins. With the tape, it is not necessary to fasten the floor plan to a drawing board. This makes it possible to roll up a large floor plan and take it any place in the factory for checking, or to the offices for approval.

If several layouts are to be made before any are approved, those that have been finished may be rolled up and put away. When blueprints of the final layout are desired, a piece of tracing cloth may be placed over the floor plan, with the templets in place, and the entire layout traced.

When winding small armatures it is easier to work while sitting down. This special stool and fixture designed and used at General Electrical Specialty Company, Jamaica, N. Y., make manipulation easier and eliminate the fatigue formerly caused by standing in one spot for long periods

•

Yellow Paint Simplifies Power House Switching

THOS. E. MILLER, *Nashville, Tenn.*

In common with a good many other standby steam plants, we have an emergency service for our station lighting. The lights are normally operated on alternating current, but for our emergency supply we depend on a steam-driven, direct-current generator. We have gradually added synchronous recorder motors, clocks, horns, and the like to the lighting system, making it impossible to switch directly to the d.c. supply. Most of these devices are for use on a.c. only and, unless they are disconnected before turning on the emergency power, are certain to be ruined.

To prevent errors or omissions in switching we checked each circuit carrying loads which could not be shifted, and painted the switch handles yellow at the respective distribution panels. The assistant operator makes it his business to pull all the yellow-handled switches before the d.c. is turned on. Of course this supplements the usual circuit names or numbers, and provides a fast method of selecting switches.

Yellow paint makes for easy reading on black surfaces such as terminal blocks, switch cabinets, and oil-switch cell doors. Many plants have discovered this fact, and employ it to their advantage.

Another way we put yellow paint to good use is in striping the handwheels on turbine-governor motors. Our machines are painted a dark green, and the handwheels are almost invisible from the operator's position. We have spaced three broad bands of yellow around the rim of each wheel, so that it can be seen to turn as the operator adjusts the turbine load.

We use yellow lettering on certain types of relays and test blocks where there is a possibility of the operator becoming confused about their purpose or service. It is to be admitted that the practice makes the switchboard look like an attempted camouflage, but it helps operators make accurate reports to the load dispatcher. Of course such special marking is only necessary where we have a congested panel of similar relays serving different purposes.

We are using brushing lacquer for all this marking as it drys quickly and, in case the marks need changing, can be completely removed with a little thinner.

•

Pump Stopped During Peak Demand Saves $80

N. T. PEF, *Chicago*

The electric bill of the plant where I am now working is about $900

per month and the demand 200 kw., or $400 for the demand alone. Among the equipment is a 60-hp. water pump which keeps full the gravity tank on the roof. The operation of this pump is automatic; it starts whenever the water level in the tank gets low. It takes half an hour to fill the tank, and then the pump does not run for 5 hours.

The maximum demand was reduced by seeing that the gravity tank was full just before the peak period, which is in the evening between 5 and 8. Just before 5 p.m. the pump is started by hand and it runs until automatically tripped off when the tank is full. In this way running the pump during the period of maximum demand is eliminated. This resulted in reducing the demand by 40 kw. and the power bill by $80 per month.

•

Look at Water Towers in the Summer

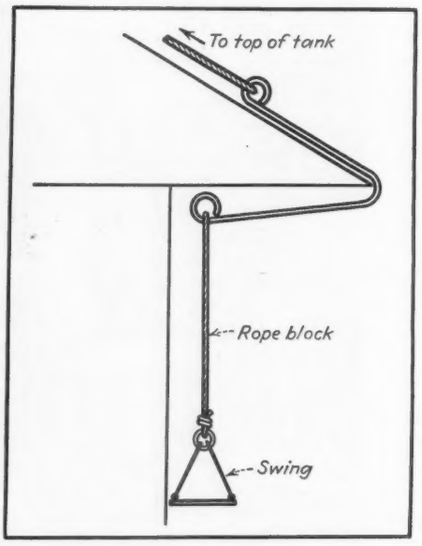
C. C. HERMANN, *Waterloo, Iowa*

Maintenance required on water towers should be done during the summer. In winter, attention must be paid mainly to proper heating of the tank to keep the water from freezing.

At the first spring inspection the tank should be emptied of water and the interior given a thorough examination to see what corrosion has done to the interior surface. Usually, the maximum corrosion will be found in the saucer of the tank. It will be necessary to clean out the saucer thoroughly by washing it and removing all loose matter. Then the corrosion will be visible. I have seen tanks in which the patches of corrosion extended over the entire bottom to a depth equal to fifty per cent of the shell thickness.

An electric welder affords the best means of making repairs. The pits should be thoroughly cleaned of all dirt, and then filled with welding rod. This method is superior to patching, unless the bad spot is entirely cut out and a patch welded on by laying a good bead on both sides of the sheet. This precaution prevents moisture from getting between the two thicknesses of steel. If the old shell is not cut away, holes should be cut through so that any moisture lodged between the old and new sheets may be evaporated.

Place the welder as near the work as possible; this usually means immediately underneath. The electrodes can be extended up over the tank rim by use of a pair of rubber-



covered cables. Where the tank is constructed with steel legs and the ground of the machine can be connected to the leg of the tank, only one wire need be taken up, as the tank serves as the ground or return wire to the machine.

Gas pockets, slag, and oxides in the weld will weaken it. Gas is formed in the weld by the presence of dirt and grease, and excessive slag and oxides will be formed by the use of a long arc. It is impossible to say just what length of arc should be used, but it is always safe to use a short one. On the other hand, a very hard weld will result from the use of an extremely short arc since carbon is carried into the weld. In general, the length of arc should about equal the diameter of the electrode used, when the current is around 250 amperes. With higher amperage, the electrode must be withdrawn slightly from the work; with lower amperage, the arc length should be decreased. The $\frac{5}{16}$ in. diameter, coated rod is best for this type of repair; the amperage should be from 175 to 225 amperes; and the voltage should be from 18 to 26.

One of the first questions asked by the owner of a tank that must be reclaimed by the welding process is —What will it cost? To give an exact answer is difficult. The only way to provide a reasonably accurate one is to go into the tank, make a sketch of the pitted areas, measure for the average depth of the pits, estimate the area of the various groups of pits, and then figure that a good arc welder will lay in about two pounds of welding rod per hour when using a 250 ampere machine and $\frac{5}{16}$ in. diameter electrodes.

But welding is not the only repair which must be made on the high tank. Painting is the next important piece of work that must be done. A tank should be painted inside every even year and outside every odd year or vice versa. Where the weather conditions are not severe or the air is not contaminated by gases, the painting period may be increased to three years.

Of course the first thing to do on a paint job is to see that the tank is drained, thoroughly cleaned, and dried. The cleaning should be done by means of air brushes vigorously applied to the outside and inside. Never paint the tank while it is full of water if the job is expected to appear first-class. The changes in day and night temperatures will cause the tank to sweat, and the moisture will ruin the paint.

Paint the outside first, then the outside can dry while the interior is being painted, and the tank will be back in service with least delay. The kind of paint for the outside is a matter for individual decision, but aluminum has been found to be highly weather-resisting and particularly adapted to conditions found on high tanks. Two and one-half pounds of aluminum paste should be used to the gallon of liquid and a gallon will cover 250 square feet with a single coat. Usually a single coat will cover sufficiently, and it is advisable to put on one coat at a time and repaint next year rather than put on a two-coat job at one time.

Aluminum may also be used for the tank legs which may be painted after the tank is back in service, but for an attractive tank black will be used. For the same reason, many tanks are painted red on top, but this is a matter of taste as aluminum will serve just as well. The inside of the tank should be painted with red lead or a coat of anti-rust paint that will not contaminate the water.

	50,000 gal. tank, 80 ft. high	*100,000 gal. tank, 80 ft. high*
Aluminum paint paste	**45 lb.**	**85 lb.**
Red lead	**90 "**	**210 "**
Varnish	**26 gal.**	**52 gal.**
Boiled linseed oil	**7 "**	**16 "**
Red enamel	**2 "**	**3 "**
Black paint	**5 "**	**13 "**
Labor	**95 hr.**	**185 hr.**

The table gives the average amount of materials and labor for two popular-sized high tanks, and after applying the necessary rates for labor and prices of material in a given community, the cost of the tank repair may be estimated.

Tanks of different sizes may be estimated in proportion to these figures. The man-hours of labor re-

quired may vary because of different equipment used. The hours given here are based on the use of the ordinary rope block swing coming from the eave of the tank. The figure shows a simple type of hook which lets the rope block hang closer to the side of the tank than does the ordinary method of swinging directly over the eave from the top of the tank.

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Bin Shelves Move— Location Records Stay

J. B. THROCKMORTON
Lyon Metal Products, Inc., Albany, N. Y.

Here is a system for locating stock items which, no matter how many shelves are put into, taken from, or moved in a section, so long as the item remains in its original location in the rack, requires no change on record cards, books, or inventory sheets.

By this method an item is located by its height above the floor and by its distance from the left-hand end of the rack. A location within six-inch radius from exact position is close enough to enable anyone to see the bin labels without difficulty. It works very much like finding a location on a map. You follow a horizontal line at a specified height until it crosses a specified vertical line.

In the sketch the rack is shown by heavy line; the light lines represent the horizontal and vertical lines used to locate the item. Of course these lines do not appear on the rack, but figures to indicate their spacing are painted on the end and along the top of the rack.

Both horizontal and vertical lines represent distances six inches apart. Horizontal lines may be referred to as 06, 10, 16, and so on, indicating six inches, one foot, one and one-half feet, and so on up. Vertical lines are designated by 01, 02, 03, 04, etc.

To illustrate, if an item is stored in rack "C" at a distance of approximately four feet, six inches above the floor and in a vertical line with distance marker seventeen shown on the top shelf, it will be recorded as located at C-46-17. The first two figures in the location record always signify heights; the last two figures show distance from left-hand end of rack. If the rack happens to be double, it will be necessary to call each side by a different letter.

This system may sound complicated, but it is really very simple. It can be learned in a few moments. It is extremely flexible, and parts can be selected faster than by other systems. It is permanent and permits unlimited expansion and changes without alteration of original record cards, so long as stock is not changed from one location to another.

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First Aid for Wet Rope

SOURCE, *National Safety Council*

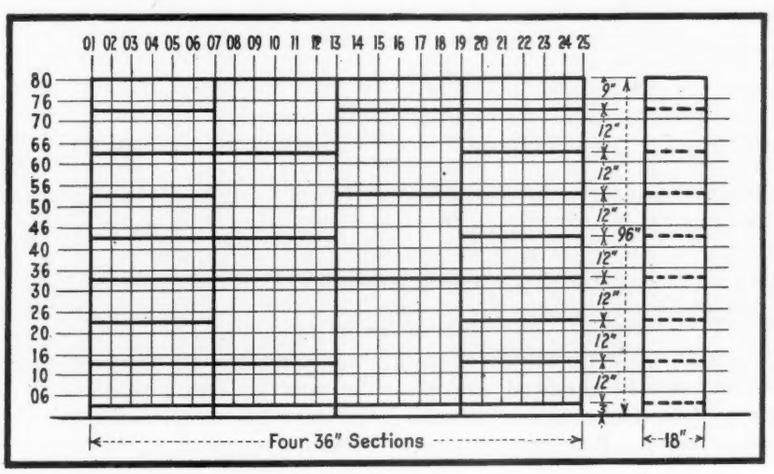
To clean a rope made of manila or other fiber, it should be hung in loops over a beam or bar placed at a convenient height. Remove sand and mud with a hose. Allow the rope to dry, after which beat or shake thoroughly to remove any remaining dirt. A carpet beater or pliable switch is effective in removing dirt or sand left after the hose stream washing. Store the rope in a dry place where it will not be exposed to high temperatures, and where air can circulate through the coils.

Rope that has been saturated with water deteriorates rapidly if not properly dried. It should be hung or laid in a loose coil in a dry place. When ropes are thrown into a corner of a storeroom or shop and covered with other material that prevents circulation of air they cannot be expected to remain in good condition.

Small ropes and tackle should be hung up, large ropes coiled on gratings raised from the floor.

Alternate wetting and drying cause more rapid deterioration than when a rope is always wet. Avoid this condition as much as possible.

When rope is dragged along the ground it is not only worn away, but picks up grit and sand that may penetrate into the interior and destroy the fiber. A rope should be carried, never dragged.



SPECIAL NOTICE

$10 will be paid for the best Operating Short submitted during the month of September. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Treat Valves Right for Maximum Service

MARK BELL, *Passaic, N. J.*

In dealing with valves, use wheel wrenches as sparingly as possible. It is better to be sure of a tight fit in the first place by grinding in the valves than to force them tight.

Nothing causes a valve to leak more than wiredrawing. Aim always to have steam valves either wide open or tight shut. To illustrate: In an ice cream plant the floors were washed several times a day. At each washing outlet temperature of the water was regulated by partly opening a steam valve arranged to pass steam into the cold water. The wiredrawing that took place played havoc with the valve disks and they required frequent renewal.

The situation was remedied by placing a thin steel disk with an orifice in the union adjoining the steam valve, the size of the orifice being such as to give the correct amount of steam for the required temperature. Steam valves were then opened wide and the wear on disks was greatly reduced.

You Want to Know

. . . and the editors will gladly tell you . . . more about the things mentioned on this page

• SLIDE RULE, new, fits any vest pocket, weighs less than an ounce. Scales are on a celluloid disk 2¾ inches in diameter. (9503)

• LAB STIRRER, said to be lowest priced on market, has stainless steel agitator, non-sparking motor, is useful for making emulsions, dissolving, dispersing, etc. (9504)

• BRONZE POWDER, the why and how of it told in a little book that a manufacturer will gladly send you. (9505)

• SIGNIFICANT developments in social and industrial legislation enacted to July 1 in the 45 states that have held special sessions this year are analyzed in a study recently made public. (9506)

• MICROMETERS — two new ones have stainless steel frames and measuring surfaces that assure permanently visible rulings. (9507)

• ALLOY, predominantly copper, has high electrical conductivity and mechanical strength equal to that of

Long shavings—see upper of two turning lathes—are not only annoying, but also retard operation, especially in automatic screw machines. Aluminum, because of the development of certain new alloys, has now been added—see lower lathe—to the list of metals termed "free cutting." (9501)

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mild steel, may therefore be used to replace bulkier copper parts, also under heat conditions where copper softens. (9508)

• ALUMINUM ladder, 24 feet long, weighs only 38 pounds, is said to be twice as strong as a wood ladder of same size. (9509)

• STRIP steel is now to be had in a finish composed of stripes rolled into the steel. Stripes vary widely in width and depth. (9510)

• HOW equipment manufacturers provide against inadequate specifications in customers' orders, is the subject of a survey whose results are now available. (9511)

• ILLUMINATION analyzer measures input as well as output, consists of light meter and combination voltmeter-ammeter. Readings obtained can be interpreted into lighting efficiency. (9512)

• ROPE, just introduced to industry, is 50-50 hemp and preformed wire. Twice the strength of manila rope of same diameter. (9513)

• SCREENS, new, are produced by electrolytic deposition of any platable metal with holes as small as 0.0002 inch. Uses include process, acoustic, photo-engraving, and textile-printing screening. (9514)

• LACQUER finish, aluminum-colored. Makers say it withstands the flexibility of live rubber without chipping or wrinkling. (9515)

• PLASTIC and liquid rubber compounds enable user to do his own rubberizing for protection against corrosion and abrasion. (9516)

• FUSE PLUG uses mercury as fusible current carrier. When fuse has blown, it is removed and tapped a few times in order to be once more ready for service. (9517)

• TIME recording clock requires only one hand to operate, records time of arrival or departure automatically when card is inserted in slot. (9518)

• PLIABILITY comparator takes guesswork out of flexibility tests on textiles, thin papers, transparent wrappings, suede leather, and other light materials. (9519)

• PAINT protector is said to triple the life of the surface to which it is applied. Stops oxidation, prevents colors from fading, protects against dust and dirt. (9520)

• BUTANE is the fuel used to operate a new switching locomotive. Said to require only eight hours to perform work that required fourteen hours under steam operation. (9521)

• SALT is being more and more widely used to combat heat sickness. An aluminum dispenser for salt tablets is non-corrosive. (9522)

• WHERE thermo-plastic wrappers requiring different heats are used on the same packaging machine, a control may be installed for each temperature required. (9523)

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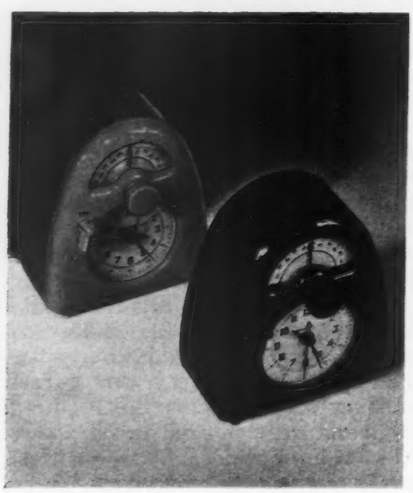
For precision timing, the new all-electric interval timer. It measures from 1 to 120 minutes. Large red second hand shows fractions of a minute. Case is molded plastic. Buzzer buzzes loud or soft, long or short. (9502)



Maintenance Can Add to Profit

Has an excellent opportunity to make all manner of savings. Enough small ones count up big in the grand total

FREDERIC OAKHILL
Plant Engineer, Bauer & Black
Division of The Kendall Company, Chicago

MUCH of the work of the plant engineer revolves around details, but these details may be the source of respectable savings, if they are watched. Here are a few such examples from our current experience, which may suggest overlooked points in other plants.

Water used in cooling rubber mills used to be thrown away when it had done its work, wasting both the water and the contained thermai units. This practice was changed so that now as the cooling water leaves the rubber mills it is passed through the ammonia condenser of the ice machine, for which it is still cool enough; then, containing the heat absorbed from both operations, it goes to the salvage water tanks from which it is pumped to the boiler make-up tank or the bleachery for further use.

The consumption of cooling water through the ice machine condenser was reduced by installing automatic regulating valves. These are actuated by the ammonia head pressure and are set to give the most economical combination of power and water costs.

Cooling water from the air compressor goes through a similar circuit. This change saves 50,000 cubic feet of water every 28 days, along with heat units formerly wasted.

Piping Without Planning

The water distribution chart shows the intermediate and final destinations of the intake through each of the four city meters from which our company draws its supply. Such a chart is very helpful in studying possible economies in the use of water, particularly when it is purchased and metered.

During the war and post-war period, in particular, much of the piping in the plant had been installed without any very definite plan. Engineering work had to be done in a hurry, and the main requirement was to prevent interferences with production.

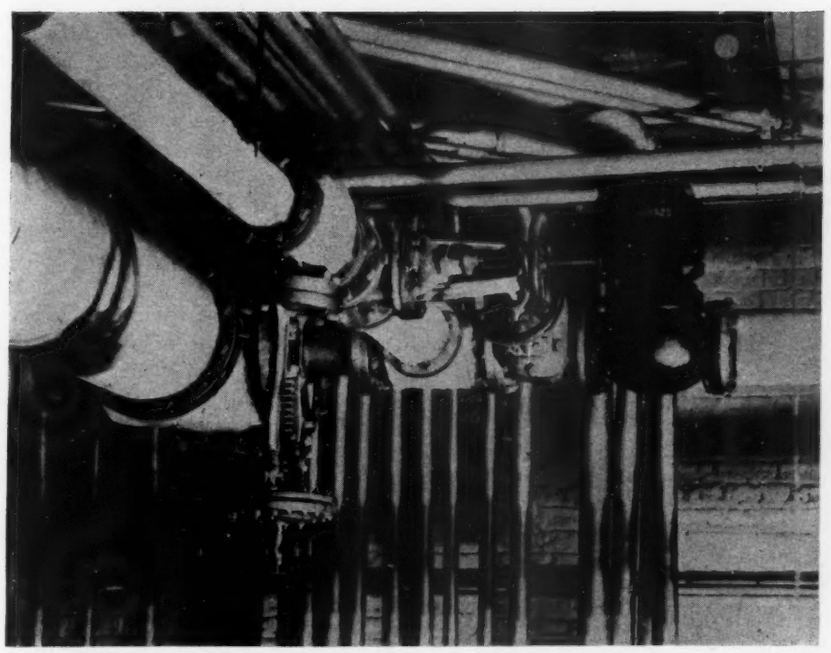
Consequently, when new water, steam, or other connections were called for, they were in many instances taken off at the handiest place. For example, there might be a plug available at one end of a 100-ft. line of piping; so instead of putting in new connections to permit taking off a run of pipe at the other end where it was needed, the maintenance crew had used the available plug and carried back another 100-ft. lead to supply the water at the other end. Or, instead of removing a main that had become too small and replacing it with a larger one, a new main of the required additional capacity was laid alongside the old one.

Study of the piping layout and gradually carrying out the alterations that were indicated, as replacements or other changes had to be made, resulted in the removal of about 2 miles of pipe that will never be missed. Much of this pipe was usable for other purposes or in other sections of the plant.

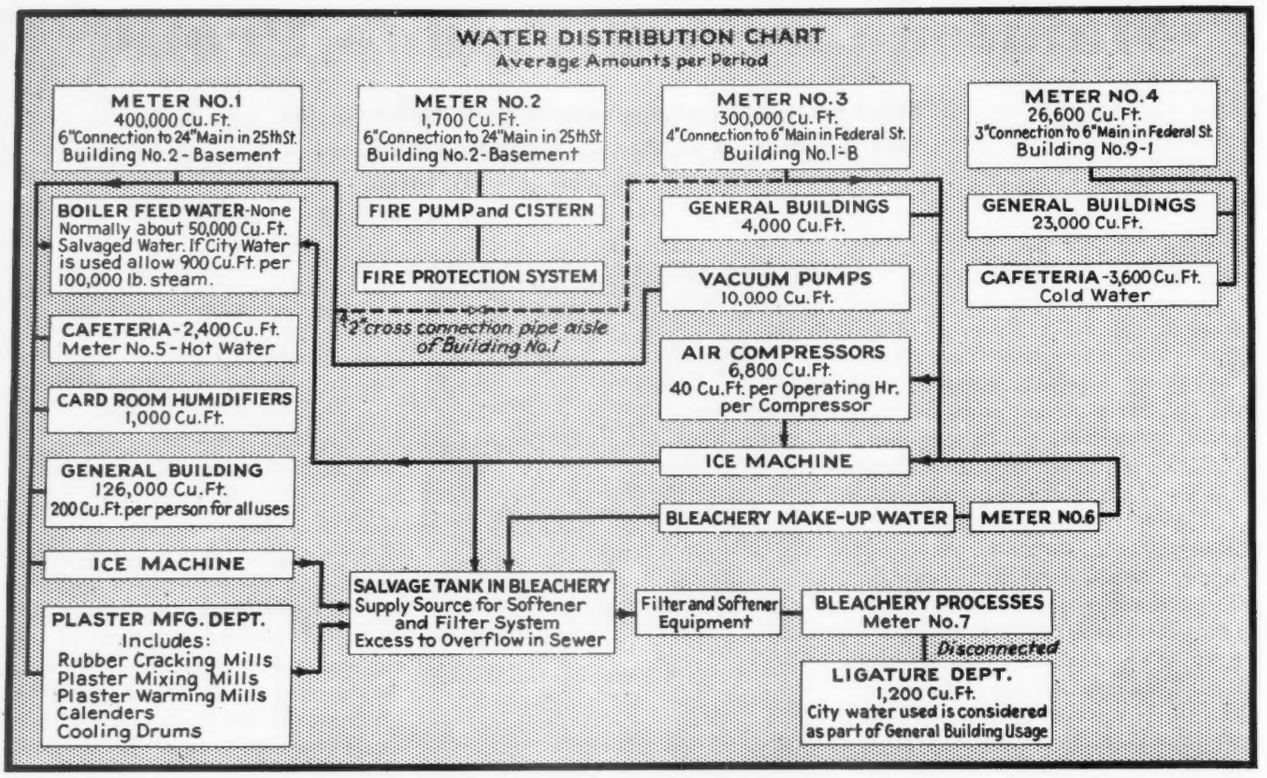
Costs Less to Keep Warm

As a result of these changes pressure was improved, maintenance costs were reduced, and there was a substantial saving all around.

It used to be the theory in heating the warehouse building that steam and coal were saved by lowering the temperature from the usual level of 70 degrees during the daytime to 50 at night. But in the morning, just at the time when starting loads were throwing an extra burden on the boilers, enough steam had to be pumped into the radiators to raise the temperature of about 1,600,000 cubic feet of air 20 degrees. This meant the use of live steam for heating whereas the exhaust would



The regulator at the right automatically permits passage of just enough steam, no more, to heat the warehouse to the desired temperature



A glance at this chart answers the question: Where does all of the water go? Figures given here on consumption are hypothetical

otherwise have sufficed for the purpose.

Now our buildings are kept at a constant temperature day and night. Theoretically, more heat is used; actually, the consumption of steam is reduced and the building is warm when the men come to work, instead of taking three or four hours to warm up.

$1,200 Pays 83 Per Cent

A further saving in the use of steam has been made by not operating the feed water heater when the supply of exhaust steam is required for other needs, such as heating the buildings, since it is cheaper to heat the feed water in the boiler than to use live steam to do it. The make-up water has already been warmed considerably by circulating it through mill rolls and so on, as mentioned previously, and when mixed with the hot condensate returns the temperature of the feed water varies from 125 to 150 degrees Fahrenheit. This is hot enough to pump directly into the boiler without further heating when there is not sufficient exhaust steam available for the heater.

Incidentally, returns from the various cooling uses are segregated so that the warmer water goes into the boiler feed tank, whereas the cooler return water is used in the bleachery for washing operations.

In the mill room, steam is used in heating the rolls. The old practice in warming up a roll was to open a valve and let the steam blow through. By redesigning the entire layout of the department and making an expenditure of $1,200 for new piping and apparatus, including steam traps, reducing valves, and other special steam equipment, a saving was made which nets about $1,000 a year.

A steam heater is used to prevent water from freezing in the storage tank on the roof. We trapped the discharge from this heater, ran it through a wall coil, and thus at no cost keep the roof hose house warm.

Generator Worth $5,000 a Year

It is usually profitable to install automatic devices such as steam traps or thermostatic controls, but such instruments must be properly maintained or they cease to control and become expensive. Regular inspection of such equipment is necessary to insure the maximum savings possible.

Power costs are usually a sizable item, and a thorough investigation of the supply and use of power often leads to worthwhile savings. We have a small generator which, although it had been idle for many years, afforded the opportunity of saving about $5,000 a year. It is just about large enough to carry the office and warehouse lighting load and a few production machines. However, by making the shifts in hours that were necessary under the NRA code and carefully scheduling production, it has been possible so far to keep the power requirements during the utility company's peak hours within the capacity of the generator. This circumstance has allowed us to purchase power under a new contract calling for a minimum use of power during the utility peak period, as a result of which our demand charges have been cut to less than half.

It is important for the executive who is endeavoring to cut plant operating costs to make a study of the metering and billing of the various purchased services. By combining the sources of such services through one meter, it is often possible materially to reduce the overall charges.

Here is an example of such a com-

(Continued on advertising page 62)

This Maintenance for Controls

Involves correct selection for the duty and keeping relays, resistors, and other diverse elements in the proper condition

B. W. JONES
Industrial Control Engineering Department
General Electric Company, Schenectady, N. Y.

MAINTENANCE of contactors was discussed in a preceding article in the August issue. Other elements of control equipment will now be taken up, from the standpoint of the attention which they require.

Resistors are important adjuncts and are encountered in many types, such as porcelain-tube, enameled resistors, open-wound, wire resistors, strip-wound, cast-grid, and so on. Some types are more likely to develop certain kinds of trouble than others.

Cast grids are usually assembled and held together by being clamped on a tie rod. The current passes from one grid unit to another across a ground face. When too much current, say several hundred amperes, is made to flow across these ground surfaces, they may develop high resistance and destroy the joint. To overcome this difficulty, these joints should be cleaned and the current path paralleled, as shown in Figure 1. This procedure will reduce the current in the middle joints, where the trouble usually occurs or is most likely to develop.

When Resistors Go Bad

Edge-wound or strip resistors usually have their terminals either brazed or welded to the strip, which prevents excess resistance from developing at this joint. In order to provide an adjustable contact on this type of resistor, a clamp type of terminal is sometimes furnished. However, since the resistor may become quite hot at this point, a bad contact is very likely to develop. Therefore, if one does develop, the best cure is to braze the terminal at the proper position.

The high-resistance cast grids that have a small cross-sectional area sometimes give trouble because of breaking, especially if they are mounted on machines that vibrate severely. The best correction for this trouble is to use an edge-wound resistor, Figure 2, which is non-breakable. This type is made of a corrosion-resisting material that is capable of withstanding very high temperatures without scaling.

The function and importance of relays are too well known to need discussion here. To cover all the relays used would be an endless task because there are many varieties of them.

A number of relays have been designed to operate as a function of time. The one that was designed first to operate on a time basis was the dashpot type. Movement of a solenoid is retarded by means of a dashpot, giving a time-current relation that is called an inverse-time characteristic.

The next type of relay that was developed was the temperature overload relay in which a heater is used to cause distortion or bending of a thermoflex (thermostatic) strip of metal. This arrangement also gives an inverse-time characteristic.

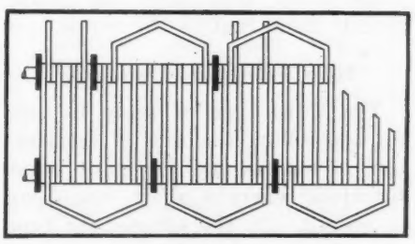


Figure 1. Heating at joints in grid resistors can be reduced by using jumpers to form parallel paths. The short, heavy black lines represent mica insulating washers

Third in development was the escapement type of relay with which an approximately constant time characteristic can be obtained.

The kind of trouble that is inherent in a dashpot was the primary reason for the development of the other types of timing relays. A dashpot is essentially a close-fitting device that is easily affected by dirt, gumming of the oil, and corrosion of the close-fitting parts. Also, the torque of the magnets varies with the position of the solenoid armature in its coil.

If Dashpots Give Trouble

This characteristic may be bothersome when a squirrel-cage induction motor driving an inertia load, such as a fan or extractor, is started by a full-voltage starter that has a dashpot type of overload relay. The armature of the solenoid may cover one-half or three-quarters of its total travel before the motor reaches full speed. Since the armature has more torque per ampere when in this partially raised position, it will not return to its initial position but will either remain where it is or perhaps gradually creep to the tripped position.

To overcome the trouble caused by dirt and gum, the dash should be cleaned frequently, say once a week or once a month, depending upon local conditions. Such attention will also keep the tendency toward corrosion from developing into trouble.

If trouble is experienced due to tripping while starting or shortly after getting up to speed, there are three things that may be done:

1. A heavier oil may be used if the relay almost holds.

2. A starting contactor can be used that does not include the overload relay in the circuit. After the motor is up to speed the running contactor can close and the starting contactor open, connecting the overload relay into the circuit. This is a rather complicated method, but it is sometimes used.

3. The final alternative is to replace the dashpot with a temperature type of overload relay. This is one of the reasons why the temperature-type overload relays were originally developed.

Since the function of a temperature overload relay is to protect a motor under all ambient temperatures, its final temperature should be the same as that of the motor, which is 90 deg. C. This means that a motor can have a 50-deg. C. rise in a 40-deg. C. ambient.

Single-Phase for Heat Test

Therefore, the relay should just trip if placed in a 90-deg. C. ambient, or in a pail of water held at that temperature. If a relay does not function correctly, it should be immersed in a pail of water kept at 90 deg. C. and adjusted so that it will just trip. The adjustment should not be made by bending the thermoflex strip. If this method of checking or adjustment does not provide the necessary degree of protection to the motor, it can be assumed that the size of the relay heater is not correct. The correct size can easily be obtained from the relay manufacturer.

There is an easy way to obtain two important heat-run tests on an installation. The first can be obtained by opening one phase of the motor while it is at rest and applying full voltage, single phase, to it. The motor will not start, and the overload relay will disconnect it before an excessive temperature is attained, provided the correct size of relay heater is being used.

If the resultant temperature was satisfactory on the above test, allow the motor to cool before the next test is made. Reconnect the phase that was opened and let the motor come up to speed in the usual manner. If the load can be adjusted, apply about 75 or 80 per cent of rated motor load. Then, while the motor is running, open one phase again so that the motor can run single-phased. Under these conditions it will draw about 135 per cent load in the loaded phase.

Let the motor run until the relay disconnects it from the line. If the motor does not develop an excessive temperature under either of these two tests, it is safe to assume that it is fully protected.

If excessive temperatures do develop, however, a heater of smaller rating should be provided. The temperature rise of the motor will vary as the square of the current ratings of the relay heaters. To illustrate: If a 10-amp. heater gives a 60-deg. C. rise, a 9-amp. heater will give a rise of 60 $(9 \div 10)^2 = 48.6$ deg. C., approximately.

A temperature overload relay does not need any such maintenance attention as outlined for dashpots, but its use does involve the observation of certain precautions. Since it is sensitive to temperature, it should not be put in a strong draft, such as that from a window or a circulating fan. If it is necessary to place it in such a position, it should be shielded by a cover. Conversely, a temperature overload relay should not be located above some source of heat, such as steam pipes. In brief, the relay should be in an ambient temperature that does not differ greatly from that of the motor.

Time Delay for Acceleration

The third type of relay is used for controlling the rate of acceleration of motors and for many other functions where a short time-delay is needed. In the escapement type of relay a pendulum is used as the governing means, which makes it necessary to mount the relay in a certain position. It is not always possible, however, to mount the relay in the proper position, and when it is in the out-of-true position it is less dependable. Shortening the pendulum makes it possible to tip the relay further from the vertical, but the shorter pendulum results in a shorter time-delay.

To overcome this limitation a new design that has a balanced pendulum has been made available. The variation in time is obtained by changing the length of the stroke. In principle the two devices are the same, but mechanically they are quite different.

Keep the Pendulum Vertical

About the only kind of trouble that has been experienced with escapement timers was failure to escape, due to the pendulum being out of plumb. The new, balanced type of escapement will overcome this difficulty.

If the old-type escapements fail to operate properly, they should be trued up so that the pendulum is vertical. However, if the application is such that it is difficult to mount and keep the relay in the proper position, use of the balanced type should be considered.

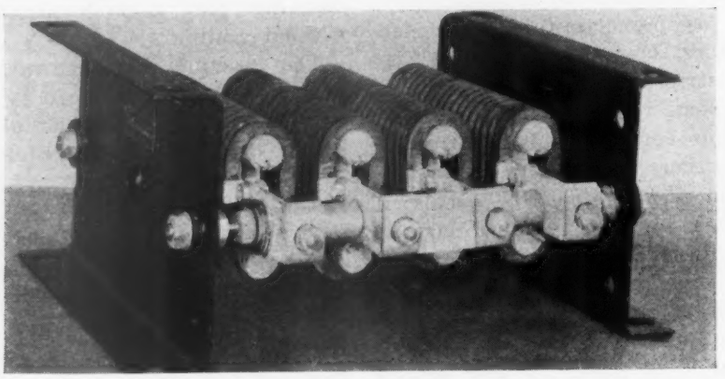


Figure 2. Edge-wound resistors will withstand severe vibration

When Corrosive Gases Are Around

Corrosive fumes in many plants, such as those manufacturing rayon, coke, sulphuric acid, nitric acid, chlorine, and so on, rapidly attack the metal parts of control devices and render them inoperative. To overcome this trouble all the operating parts are frequently immersed in oil in a container that is capable of withstanding the corrosive atmosphere. The oil container is made either of cast iron or of heavy boiler plate steel, which is given a protective coating of a paint that is capable of withstanding the fumes or gases encountered.

When it is impracticable to oil-immerse a given type of control, the equipment is inclosed in a heavy case with a tight, gasketed cover. The inclosing case is protected with a suitable corrosion-resisting paint.

3 Men; 2,000 Motors

And very little down time. At Wright, motor maintenance is on a simple but effective basis

ROBERT C. HOWELL
Chief Electrician
Wright Aeronautical Corporation
Paterson, N. J.

WE had fewer motors and more men in the freer more affluent days—but now we keep something over 2,000 motors running with only three electrical maintenance men to nurse them. And when I say running, I mean that the amount of machine down time due to motor failures is very slight—as little as any plant can reasonably expect.

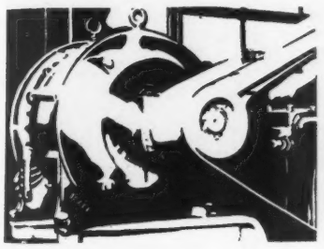
It isn't because we are completely outfitted with totally inclosed motors. As a matter of fact, with the exception of certain of our very large motors which are synchronous, we have only open-type 440-volt, 3-phase squirrel-cage induction motors with compensators or across-the-line starters.

Our electrical maintenance crew consists of a day force of 5 and a night force of 2. Two of the day force are construction men, have nothing to do with motor upkeep. A third day man is our motor rewinder—we do nearly all our own rewinding now—and has practically no time for anything else. The two remaining members of the day crew take care of motors, but that is only part of their job. All the orders for fans and gadgets, light replacements, and the hundred and one little fixing and changing jobs that call for the plant electricians are theirs to execute.

Night Men Inspect

To the night crew falls the job of motor inspection. But only one of these two can be delegated to motors. The night is 16 hours long and each man takes an 8-hour shift. One man's time is fully occupied with maintenance of our eight electric trucks, charging them, inspecting and adjusting horns and brakes, and small bench jobs.

The other night man goes the rounds and checks the motors. He takes approximately two floors a night, about 200 motors, and so gets



to each motor about once every two weeks. His inspection consists of checking up on air gap and bearing wear, cleaning with an air blast, oiling and greasing, checking compensator contacts, and seeing that fuses and overload relays function properly.

He is an inspector and with 200 motors a night to check cannot be expected to make any but minor adjustments.

The notebook he carries in his pocket is his main tool. In it he notes the machine number of any motor that shows signs of approaching failure. Each morning he gives his notes to the chief electrician who details one of the day crew to attend to the motors noted.

This is our main preventive measure. But there are others. When a relay opens from an overload it may not be reclosed except by a maintenance electrician who first investigates the cause of the overload and makes certain that the motor is not faulty. In this way we anticipate serious trouble. To be sure, we have one or two "smart" operators working on bonus who know ways of "fixing" fuses and breakers so they won't cut out a motor.

Big Motors Better Serviced

Also, when a production machine is closed down for repairs, the foreman notifies us and we take the opportunity to overhaul the motor, clean it thoroughly and make certain that it is in good shape.

The larger, more important motors that drive lineshafts and groups of machines or dynamos get better service. We don't measure insulation resistance of the fractional horsepower motors but the big ones get it every three months or oftener. And they are cleaned every month. Elevator motors are cleaned weekly. For cleaning we use a mixture of high-test gasoline and carbon tetrachloride. As it happens our production requires cleaning tanks on almost every floor, which makes it easy for us.

For lubrication we have standardized on a brand of non-fluid oils and greases that beat anything we have ever known for this purpose.

Not Much Paperwork

Nothing has been said about records. There isn't much to say. We confine paperwork to absolute essentials—an insulation resistance test record for the big motors; a motor record card for each motor; and an inspection record form for each motor.

There are only a few motors on which insulation test records are kept. The motor record cards are made out once and for all. They are referred to only for data to enable us to specify accurately parts needed for replacement. The inspection records are the only forms involving much clerking. They are filled in each morning from the night man's report. These forms are loose leaf bound in the order in which the motors are inspected, so it is a simple matter to run through the lot and note the date in figures.

You wouldn't exactly call this a system. All we have is the simplest set of rules we know of for getting the work done. It's that we're concerned with, not with having a pretty record to show what work we did and leaving no time to do the work.

In the milling machine department 31 machines are group-driven by one 20-hp. motor. This is the largest number of machines in any one group. There are three lineshafts in part of the area; two in the remainder

We Like Group Drives

Making groups small insures flexibility under varying production demands and an inspection every day keeps trouble away

P. C. NACE
Superintendent of Maintenance
American Machine & Foundry Company
Brooklyn, N. Y.

WHEN we moved into our present plant some years ago the great majority of our machines were arranged to be driven in groups, from lineshafts. That system of driving had proved satisfactory in our old plant and we saw no reason for changing, although our production problems are in some respects much like those encountered in a job shop.

This condition arises because our product is special machines, such as cigar and cigarette-making machinery, bread slicers and wrappers, and so on. In all, we build regularly about 60 different machines of our own design. In addition we do contract work of all kinds. This also changes the machine demand since these outside jobs may be all lathe, screw machine, or milling machine work. Hence, it often happens that when certain machines and departments are busy, others are not. Then, within a comparatively short time that condition may be more or less completely reversed.

Nevertheless, our production machine drives are laid out to obtain a high degree of flexibility, so that we can operate needed machines without much waste of power in such lineshafts and belts as must for the time being run idle.

Three Principles to Follow

Out of our long experience in driving machine tools and other equipment from lineshafts we have learned that it pays to adhere closely to three important, general principles. These principles are:

1. Drive only a comparatively small number of machines in a group. The number of machines in different groups will naturally vary, since such factors as physical location of the machines, amount of power required to drive each one, average number of hours that a machine is used per week or per month, and so on, have an important influence. These and any other factors that have a bearing on the problem should be considered carefully.

2. Keep all power transmission equipment, such as belts, lineshafts, hangers, hanger bearings, and the like, in good condition.

3. See that the motors driving the lineshafts are properly loaded. Obviously, this involves proper selection of motor sizes when the installation is first put in. After that, checks should be made from time to time in order to make sure that changes in conditions do not result in considerable increases or decreases in the loads on the motors.

Both conditions are objectionable but on the whole overloading, unless it is excessive, is likely to be preferable to decided underloading. Good motors will carry a reasonable overload continuously, without harm. They will run somewhat hotter, to be sure, but they can easily be protected electrically so that there is little danger of burnout or serious damage.

The effects of underloading alternating-current induction motors are reflected in the electrical system, rather than in the motors. When underloaded a motor will run cool, but its power factor will be low. If any considerable proportion of the induction motors in a plant are operated at loads appreciably below their rating, the plant power factor will be lower than is desirable. This condition in turn will bring about effects that are well known to be both undesirable and costly.

Our plant contains about 450,000 square feet of floor space, including office and other areas that are not devoted to manufacturing operations. Production is concentrated on four floors of a six-story building, although certain operations or processes are conducted on the other two floors.

About 1,300 machine tools are operated in eighteen more or less separate and distinct production departments such as screw machine, milling, lathe, planer, toolroom, sheet metal and punchpress, gear cutting, foundry, blacksmith shop, metal polishing and finishing, and

assembly. From this incomplete list it will be seen that our production equipment ranges from polishing and buffing equipment to large planers, boring mills, and grinding machines.

As a rule our largest tools, planers and boring mills, are individually driven by direct-current motors. They require close speed regulation over a rather wide range and this can best be obtained with direct-current motor drives.

Some special machines that are used only part of the time, or that require a large amount of power, are likewise individually driven. In such cases individual drive is preferable and probably more economical than driving from a lineshaft.

Mostly Group Drive

The remainder of our equipment is group-driven from lineshafts through countershafts equipped with tight-and-loose pulleys.

Lineshafts are supported in adjustable hangers mounted on wooden stringers that are in turn attached to the steel ceiling beams. Most of the hanger bearings are of the plain, ring-oiling type. On a few lineshafts the speed has been raised during the past few years and these hangers have been replaced with the ball- or roller-bearing type.

Driving motors are all mounted overhead, out of the way but easily accessible. These motors are all rated 60 cycles, 440 volts, two-phase, 1,200 r.p.m., and are of the squirrel-cage type.

Small Motors Are Large Enough

Practically all of the lineshaft motors are of 15- or 20-hp. capacity. This rating is a logical result of our policy of limiting the number of machines driven from one lineshaft. If a certain department contains a large number of machines, as some of ours do, we will install two or more lineshafts so that each drives only as many machines as can be handled by, say, a 20-hp. motor. Keeping the groups small gives us the very important advantage of flexibility in meeting changes in production demands. If a small number of machines will handle the production required of a certain department, it is not necessary to operate a long lineshaft and a large number of countershafts in order to run a few machines.

Keeping this objective in mind, we are driving anywhere from 4 to about 30 machines from one lineshaft.

Installation of new equipment, changes in layout, and all of the other alterations that are constantly being made in a large plant tend to increase the loads on some groups and decrease them on others. Therefore, we are now checking up the loads on all of our lineshaft motors and making such shifts and replacements as are indicated by the results of our tests. As was mentioned earlier in this article, the loads on the motors are reflected in the power factor of the plant's electrical system. One of our reasons for checking the loads at this time is to raise our power factor as high as possible.

Belts and other mechanical power drive equipment are looked after by four belt repairmen and a beltmaker. One repairman is assigned to each of the four floors on which the manufacturing departments are located. These men have the responsibility of inspecting all machine belts and keeping them clean, properly dressed, and under the correct tension. If any belt trouble occurs it is up to them to remedy it, if possible. When belts become frayed, or the laps or plies open up, or other serious trouble develops, the repairman reports it at once to the beltmaker.

In addition, the repairmen tend to the oiling of the line- and countershafts.

The beltmaker has a well-equipped shop in which he can do any work that may be required. One of his duties is to make a thorough inspection of all main belts once or twice a year. If a belt has become oil-soaked, or needs to be thoroughly cleaned, it is sent to the shop. When necessary, belts are spliced, bad spots are replaced, laps and plies are recemented. In short, they are thoroughly rebuilt.

When a belt reaches the stage where it is not economical or advisable to try to restore it to satisfactory condition it is cut down to a narrower width, or the good leather is salvaged and used in repairing other belts. When a piece of leather is discarded we are sure that it does not owe us any money; it has given all of the service that it is capable of giving.

We find that it pays us to keep our belts in good condition by careful inspection and maintenance. Not only are trouble and delays reduced almost to the vanishing point, but we get longer life and better service from our belts, which means the maximum return from the money invested in them.

Whatever treatment a belt may need, it can get it in the belt repair shop. As soon as any defects are discovered in a belt, it is removed from service and put in first-class condition

When You Buy Power

Thorough understanding of all clauses in the contract with the utility will help to avoid high power costs and arguments

L. O. VESER
Power Engineer, Lockwood Greene Engineers, Inc.
New York

ANY BUSINESS MAN will admit that it is extremely unwise, not to say foolish, to sign any contract or paper without knowing exactly what it means and what obligations it entails. Power contracts seem to be an exception.

They are often signed by executives who have only a vague idea of what the various clauses mean, or why they are there. It is not surprising, therefore, that industrial consumers often fail to realize how unit costs of power can be kept to a minimum under the terms of the contract. The result is that they may pay too much for their power.

Public utility experts and the State Utility Commissions have spent many years in developing power schedules that are fair to the distributor and the consumer. Today, rate-making is in the nature of an exact science.

A Rate for Each Class of Service

There has been much agitation for standardization in rate schedule forms. However, this has its limitations and objections, due to diversity of power usage; so there are now in use a number of different forms of schedules that have been developed to conform to viewpoints of rate experts and to suit the needs of different classes of consumers.

All states have some form of commission that reviews and approves rate schedules, which must be filed with them before becoming effective. Then they become published schedules available to any consumer who can qualify for their conditions. Usually the power company files with the commission a number of schedules suited to different classes of service within its territory. The class of business, power requirements, and the period during which power will be used determine which schedule is best suited.

The most common form of contract is based on a rate schedule having two charges; one is a graduated demand and the other a graduated energy charge. The demand may be designated in kilowatts, (kw.), kilovolt-amperes (kva.), or horsepower. The energy is designated in kilowatt-hours (kw.-hr.).

Clauses in the Contract

Such contracts always embody a clause defining the method of determining the demand; usually there are additional clauses which often tend to operate as a penalty by increasing the billing demand. Demand is measured by a graphic meter, usually over 5-, 15- or 30-minute intervals. Common methods of determining the demand to be used as a basis for billing are:

1. The average of the 5-minute maximum demand for all working days during the month.
2. The highest average rate of demand for 15- or 30-minute intervals during the month.
3. When the demand is in kva., by dividing the maximum demand in kw. for 15 or 30 minutes, during the month, by the average monthly power factor.

Stipulations are usually included to establish the minimum billing demand. Examples are:

1. In no case shall the billing demand be less than 75 per cent of the highest maximum demand during the previous 12 months ending with the month under consideration.
2. In no case shall the billing demand be less than 75 per cent of the contract demand.
3. If the 15- or 30-minute maximum demand is less than 50 per cent of the maximum momentary demand, the billing demand shall be 50 per cent of such maximum momentary demand.

A contract demand may be determined from the consumer's load conditions prior to drawing up the contract, or it may be stipulated as the average of a number of demand intervals during each month.

Under a power factor clause a penalty will result in the form of a higher demand billing unless the consumer maintains power factor at or above a stipulated figure, usually 80 or 85 per cent.

Where the demand charge is on a kva. basis low power factor is automatically penalized in a higher billing. Under this form of demand schedule it is usually advantageous for the customer to correct power factor.

Demand forms of contracts make the hours use of demand a very important factor. If a plant operates 80 hours a week the net rate for power will be considerably lower than when operating 40 hours a week. The demand charge will be the same in either case, but with more hours of usage more energy is consumed and since this additional energy is purchased at the lower rates on the energy schedule, the net cost a kw.-hr. is reduced.

Keep Demand Low

Demand itself is an important factor and should be kept as low as production conditions allow. Maximum demands are usually caused by the larger motors: frequently by a single large motor. Planning of factory operations often makes it possible to reduce demand without jeopardizing production.

A number of adjustment factors may have to be applied to the demand charge in order to determine how the schedule will operate and what the final cost of power will be. Often the demand charge is as much, or more, than the energy.

To determine how a particular schedule will affect the final or net

cost of power it is necessary to apply the schedule rates and any special rules to the actual load conditions. This is a simple matter when all of the load conditions are known. Where there are not sufficient or reliable load data available, tests should be made over a long enough period to determine average conditions.

Several schedules may be applicable, in which case it becomes necessary to make comparative analyses in order to determine which one is most desirable.

Some power companies have schedules for so-called "off-peak" power, or power used during periods of low system demand. Hours when such power may be used are definitely specified and are often subject to seasonal change. Rates for such power are lower than in standard schedules, and when it is available savings can be effected by consumers who are in position to utilize it.

Off-peak power is usually supplied in conjunction with power on one of the regular schedules and is covered by a rider in the contract.

Fuel and Power Factor Clauses

Another form of low-cost power is so-called "dump" power, which is the surplus that the utility may be able to furnish over the normal demands. Such power may be available during any period of the day. Contracts for it are usually somewhat special, may be drawn up in a number of forms.

The principal objection to such power, from the consumer's standpoint, is the uncertainty of its availability when it can be used.

During the World War and later, when fuel costs fluctuated widely, fuel cost surcharge clauses were quite common in power contracts, and are occasionally met now. These surcharges are made by adding to or deducting from the net monthly billing a stipulated amount, usually a fraction of a mill a kw.-hr., for some specific increment by which the delivered cost of coal exceeds or is less than some basic cost price.

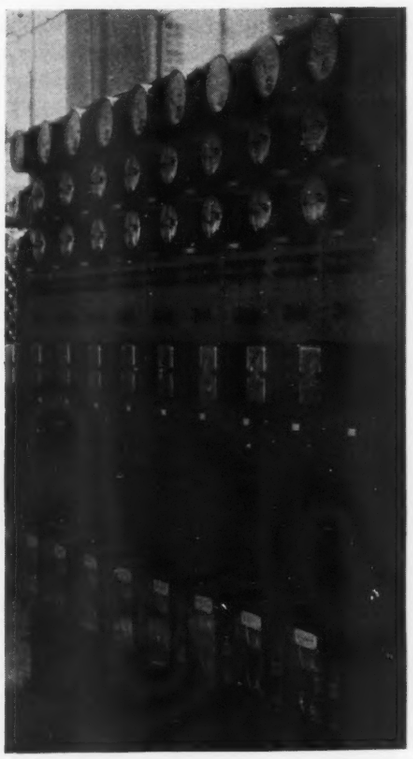
These clauses are inserted in fairness to the distributor, but they are somewhat confusing to the consumer, since he has no simple way to check the fuel cost. The calculations are sometimes a bit complicated, and with fluctuating fuel costs power cost shows a corresponding change.

Power factor of the average plant load is low, and the effect is to load up the power company's generators, transformers, and lines with idle current. Therefore, many contracts contain clauses that penalize low power factor, usually in the demand charge. This penalty may be rather severe and justify corrective measures to reduce or eliminate it.

The effect of such a clause should be carefully analyzed by applying its provisions to the plant load conditions. If the annual penalty is considerable the possibilities for power factor improvement should be investigated.

Frequently a contract will include a power factor clause that is not being exercised, but this is no assurance that it may not be enforced during the term of the contract.

It is always advantageous to have a contract wherein lighting is combined with power in the same rate schedule. Most schedules permit this arrangement, with a provision that the lighting load must not exceed some stipulated amount. Sometimes it is limited to a certain percentage of the total demand, or to a certain number of kilowatt-hours for each kw. of contract demand.



The average factory need not be disturbed over these clauses since the lighting load usually comes well within the schedule limitations. Occasionally a factory may have an electrical load that is largely lighting, and may be placed in a classification calling for a schedule having rather high rates due to the preponderance of lighting load.

A power company usually has schedules for both primary- and secondary-voltage power, although the primary supply voltage is the same in both cases. Transformers are necessary with both schedules.

Primary- and Secondary-Voltage Service

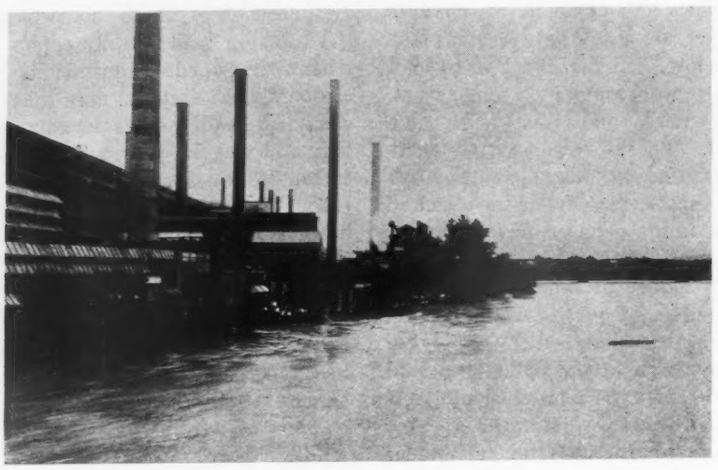
The schedule for primary-voltage power will carry a somewhat lower net rate, but the consumer must bear the cost of the transformers and their appurtenances, and the losses in them. If power is purchased at the secondary voltage the net rate will be higher, since the power company furnishes the transformer equipment and stands the losses. In the long run the cost of power under either of these schedules will be about the same.

It is generally more satisfactory for a large consumer to purchase power on the primary-voltage schedule. If a small consumer wishes to avoid the investment in transforming equipment and its upkeep there is no objection to the secondary-voltage schedule.

Most power contracts are for a period of one year, and embody clauses for automatic renewal for a similar period unless cancelled by either party upon written notice 60 or 90 days before expiration. When a different form of contract is desired, it is, therefore, advisable to keep such clauses in mind.

A contract period of one year is usually satisfactory. If there are no changes in the rate schedule and the consumer is satisfied with his contract, it automatically renews itself. However, if negotiation of a new contract is found desirable, it leaves the way open for this within a period of not more than one year.

In some instances, however, contracts running more than one year are desirable. This is particularly true where a large consumer has a special schedule that affords a very attractive rate, and there may have been a considerable investment in making the service available.



Going down! At the peak of the flood the water was about 2 feet higher. This and the other illustrations were taken at Corning Glass Works, Corning, N. Y., when on July 7 and 8 the Chemung River rose 18 feet above normal level

After the Flood

Getting equipment in condition for service takes time, must be carefully done

G. A. VAN BRUNT
Associate Editor

WHAT to do with equipment that has been submerged in flood waters is a live question right now in many plants. Obviously, the proper treatment in a given case depends on a number of factors. The general principles outlined below will serve as a guide; modifications may be made as necessary.

Electrical equipment usually suffers most and requires prompt, skillful treatment to avoid serious damage. First, remove all dirt and grease or oil. Brushes and a stream of water under moderate pressure can be used. After this preliminary cleaning send all small motors and other apparatus to the repair shop. Usually it is more convenient, or necessary, to dry out large motors in place.

Empty the bearings and clean out thoroughly. Flood water always contains silt, which is likely to cause serious damage. Adherent grease or oil may be removed with gasoline or other solvent.

Keep an Eye on the Thermometer

Small motors can best be dried out in an oven, at a temperature not exceeding 85 deg. C. (185 deg. F.), for Class A insulation. If an oven is not available a suitable inclosure can be made from wood, galvanized iron, or tarpaulins. Be sure to provide adequate ventilation. Heat can be supplied by steam coils, resistance heaters, charcoal burners, or gasoline torches. When the latter are used, direct the flame through a screened pipe, to catch any sparks.

Completion of the drying period can conveniently be determined by an insulation resistance test. When dry it is advisable to dip the windings in a good insulating varnish, and bake.

Compensators, transformers, and other apparatus should be handled in much the same way. If oil-filled, drain out and remove all dirt. Coils may be dried out in an oven, or by passing enough low-voltage current through them to produce a temperature of not more than 85 deg. C.

When windings are heated in this way, take care to avoid hot spots. Interior portions of the windings will reach a higher temperature than the outside; therefore, use thermometers to check the rise.

Filter the oil or put it through a centrifugal drier, and then test.

Large motors may be dried out in place by surrounding them with a canvas or other inclosure and applying external heat, or circulating low-voltage current through the windings. If this method is used, hot-spot temperatures must be checked with a thermometer. It is essential that the temperature be kept within safe limits, in order to avoid scorching the insulation, or risking damage by escaping steam.

Synchronous motors may be dried out by rotating them slowly by external power, with low excitation and short-circuited terminals. Open and close circuits only when the machine is at standstill. Drying can also be accomplished at standstill by circulating low-voltage current through the armature and field.

Large, shunt-wound, d.c. motors may be rotated slowly, with weak field excitation and short-circuited armatures. Or, the fields may also be dried out at standstill with external, low-voltage current.

As mentioned previously, resistance tests afford one of the most convenient means of determining the condition of the insulation. It is advisable to take readings at regular intervals during the drying process and plot a curve. If the insulation has not been injured me-

chanically, and all other parts are in good condition, the curve will eventually approach a constant value of resistance and indicate when the excess moisture has been driven out.

Before putting the machine in service give windings and conductors two or three coats of a good, air-drying varnish.

When Gears and Belts Get Wet

Some elements of mechanical power transmission equipment may be seriously damaged by a flood; others will suffer little harm if properly treated.

Speed reducers, chain drives, open gearing, and the like can readily be restored to good condition by careful cleaning. Reservoirs of speed reducers should be drained of oil and water, and be well cleaned. Wash or wipe worms, gears, and bearings free from grit, dirt, and oil. Entrance of any abrasive matter into anti-friction bearings is likely to be disastrous. Therefore, unless it is certain that the seals have kept all water out, the bearings should be carefully washed out and cleaned.

Give power transmission chains the same general treatment. Casings must be emptied and washed. Wash chains in clean gasoline or other solvent until free from all dirt. As in the case of bearings, any abrasive material that works its way into the numerous bearing surfaces of a finely made, high-speed chain is likely to cause much damage.

When power transmission belts are submerged in flood water the effects vary widely with the different types. Rubber belts, for example, usually suffer no harm. If the rubber covering is intact water can not penetrate into the fabric, and no damage is done. After removal of all mud and debris the belt is ready for service, as soon as it has been wiped, or allowed to dry.

When water gets into the fabric of a rubber belt, through cuts or tears in the covering, it will be necessary to cut out the damaged portion.

Waterproof leather belts will suffer little or no harm. Ordinary belts will absorb a considerable amount of water and if waterproof cement has not been used for the laps and plies they will come apart and complete rebuilding will be necessary.

Proper drying of leather belts is extremely important. It is essential that it be done very slowly. As soon as the water has gone down clean off all mud and dirt, using a hose, if available, and cold water. Never use steam or hot water. Then coat the belt *liberally* on both sides with a good belt dressing, or neatsfoot or cod oil. The wet leather will absorb little or none of the oil, which will form a coating that will retard evaporation of the moisture.

When leather is allowed to dry too quickly it almost invariably becomes brittle and cracks or "burns." Do not apply heat to the belt; let it dry naturally, in the open air. As it dries out, much of the dressing or oil will soak in. Any excess can be wiped off. When the belt feels dry to the touch, it can be put back in service. Before doing so, examine it carefully for lap or ply separation.

If necessary to remove the belt from the pulleys, hang it up or place it on edge on the floor, to insure even drying.

Take Time to Do a Good Job

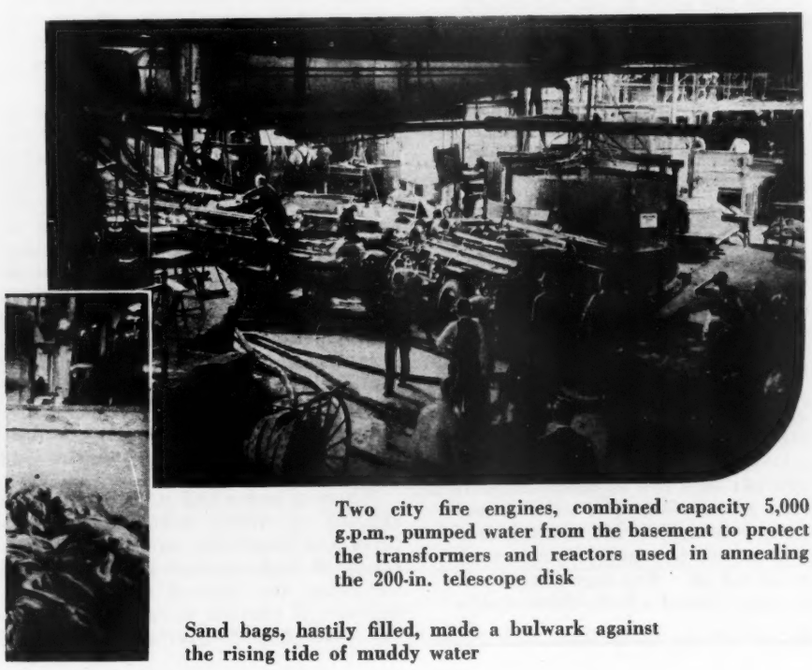
Fabric belts are usually, not always, given a waterproofing treatment. A good, waterproof belt will suffer little harm from short immersion, and after being cleaned off and allowed to dry it can be put back into service. If it has been submerged for a considerable period it is advisable to check the tension. When much moisture has been absorbed a fabric belt will tend to shrink and put undue stress on shafts and bearings.

Non-waterproof belts will shrink considerably when soaked, and should be removed at once in order to prevent damage to hangers or other parts. If possible stretch the belts out flat, under tension, and allow to dry naturally. This will help to avoid curling or warping. After a belt of this type has dried out it will likely be necessary to set in a new piece, to compensate for shrinkage.

In general, the treatment outlined above applies also to conveyor belts.

When cleaning production and other machinery after a flood one must be guided by the nature of the equipment and its condition. Oil wells should, of course, be emptied and all bearings and working parts thoroughly cleaned. Little is to be gained, much may be lost, by too much haste.

Machine tools, in particular, must be gone over very carefully. More or less complete disassembly and careful removal of all dirt and oil or grease are necessary. After the machines have been put together again they must be painstakingly adjusted and tested for alignment and accuracy. If such tests show no defects it is advisable to run the bearings in for a sufficient period to make sure that they are in proper operating condition.



Two city fire engines, combined capacity 5,000 g.p.m., pumped water from the basement to protect the transformers and reactors used in annealing the 200-in. telescope disk

Sand bags, hastily filled, made a bulwark against the rising tide of muddy water

Questions *and* Answers

Conducted by G. A. VAN BRUNT

Overload Protection for Motors

Wiring diagrams for some equipment driven by 3- or 5-hp. motors which we have been installing show that a pressure switch which cuts the motors out at a predetermined pressure contains a thermal overload device that opens only two lines of a three-phase, three-wire, or two-phase, four-wire circuit. Therefore, in the case of a three-phase job one wire of the circuit will be carried straight through to the motor; with a two-phase, four-wire installation, two wires will be solidly connected. Is this protection adequate? G.W.—St. Louis

THE CODE requires that each ungrounded conductor in two- and three-phase systems be protected by some overload device.

It is permissible to use protective devices for the motor in only two legs, but I have found that it is best to have overload protection that opens all ungrounded conductors in the event of trouble. For example, if the supply is three-phase, Y-connected, two wires can be opened but current can still flow over the third wire to ground. In the present instance two leads would be opened by the thermal cutouts, but current would continue to flow over the other wire, at reduced voltage, and probably burn out the motor.

We are using a switch similar to the one described, but it is used in conjunction with a circuit breaker having overload coils in all three phases.

WILBUR O. ZINN, *Chicago*

THIS protection is not adequate for polyphase motors because all three legs of a three-phase circuit, and the four legs of a two-phase, should be disconnected when the motor is not running. If the winding of the motor should become grounded, the unprotected wires will carry current to the grounded point through the winding at approximately half-voltage and burn it out.

We have found that the best way to eliminate this possibility is to install a magnetic switch between the pressure switch and the motor, with the control circuit of the magnetic switch running through the pressure switch.

When the latter opens it breaks the coil circuit of the magnetic switch, thus disconnecting all three or four lines to the motor, as the case may be, and giving it perfect protection.

HARLEY BOSLER, *Bosler Electric Salem, Ore.*

?

What are your most troublesome problems? Free-for-all discussion of them will help you and other readers

Answers Wanted

Separating Maintenance and Repair Charges

I should like to know on what basis other readers distinguish between maintenance charges and charges for repairs to buildings and machinery. That is, where do you consider that the one stops and the other begins? Do you base the distinction on the kind of work done, or on its cost, or on some other factor? G.E.—Jersey City

One Motor, Two Lineshafts

In laying out a group drive a question has come up as to whether it is better to drive two parallel lineshafts by belting from one to the other, or by using an extended shaft motor, with a pulley at each end. It is estimated that 25 hp. will be required to drive the two shafts, which are 28 feet apart. We do not want to use two motors; therefore, we shall have to use one of the methods mentioned above. Which do you recommend? Why? K.D.A.—Louisville

How Determine Transformer Losses?

What is a simple and accurate way of determining the over-all losses in a bank of three 333-kva., single-phase transformers, rated 4,600/440 volts? These transformers supply power and light and when the plant is operating they are loaded fairly close to capacity, but on weekends and holidays they carry only a small lighting load. I want to find out whether the losses at these periods of light load are sufficient to warrant installation of a small transformer to supply the lighting load and permit the large transformers to be cut off. Any suggestions will be appreciated. G.J.—Minneapolis

Does Temperature Affect Thermal Overload Relays?

I should like to know whether other readers allow for higher temperatures in summer, when setting thermal overload relays. In our plant the temperature around some motors runs 120 deg. F., or higher and it seems to me that the relays operate more frequently than in winter. It would seem that a high surrounding temperature must have some effect on such relays, so that they would stop a motor on a smaller overload, possibly on loads little above normal. Conversely, it is easy to believe that thermal relays exposed to extreme winter temperatures would permit a greater overload to be carried than in summer. When a motor and its relays are exposed to the same temperature in each case perhaps the surrounding temperature can be neglected. However, some of our starters are exposed to higher, some to lower, temperatures than the motors which they control. What can, or should, be done in such cases? H.H.—St. Louis

THERMAL overload relays of the adjustable type, in which the trip unit consists of a bimetallic strip, can be set for ambient temperature compensation within rather wide limits. Heating effect of the current through the unit is the cause of the change in shape of the tripping strip, but under a high ambient temperature a smaller current than normal will suffice to trip the relay and open the motor circuit on loads or overloads below the relay setting.

Likewise, when thermal units are exposed to temperatures much below the standard ambient of 40 deg. C. (104 deg. F.) their tripping action is adversely affected in the opposite direction.

Since the function of overload relays is to protect the motor from sustained overloads that might result in injurious overheating, any changes in the setting to compensate for surrounding temperature conditions should be made cautiously. Make sure that the motor load and all circuits are normal. Loose connections within the relay sometimes cause heating which affects its accuracy.

Where a motor and its controller are exposed to widely different temperatures and shutdowns are obviously the result of high ambient temperature of the relay, the thermal unit should be adjusted if possible to carry the neces-

(Continued on advertising page 72)

Troubles of Air Circuit Breakers

AIR-BREAK circuit breakers are of several types that differ considerably in details, but all are designed to accomplish the same functions: namely, to close and open an electrical circuit. For present purposes air breakers may be classified as:

1. Non-automatic (a) With overload relays only.
   (b) With overload and no-voltage relays.
2. Automatic (a) With thermal overload relays.
   (b) With solenoid overload relays.

On the non-automatic types equipped with no-voltage relays the relay acts as a hold-in coil and the breaker will not stay closed unless the no-voltage coil is energized.

With breakers of the automatic types the hold-in coil, which is always energized while the breaker is closed, acts as a no-voltage relay energized and de-energized by start and stop buttons.

Contacts on breakers of any considerable size are of laminated copper and make a wiping contact. To protect them from damage by the arc formed when the breaker opens, secondary carbon contacts or a magnetic blowout are provided. Secondary copper contacts may or may not also be used.

When used with synchronous motors the closing coil of the breaker may be excited either by direct or alternating current, preferably the former fed from the exciter circuit when the source of excitation is separate. Where the exciter is direct-connected to the motor, alternating current only can be used to excite the closing coil.

On automatically operated synchronous motor circuits, pilot lamps are used to indicate the operating sequence, in the same way as with oil breakers.

The tripping circuit may include either thermal overload relays or relays operated from current transformers. There is no separate opening coil as in oil breakers, the closing coil accomplishing both functions.

SYMPTOM	TROUBLE	CAUSE	REMEDY
NON-AUTOMATIC BREAKERS			
1. Breaker will not close.	(a) Overload relays set too low. (b) Tripping toggle fouled.	(a) Improper setting of overload relays. (b) Tripping toggle did not fall in neutral position when opened.	(a) Raise relay setting. (b) If bent, straighten toggle. If out of place, adjust to proper position.
2. Breaker equipped with overload relays only will not open on overload.	Overload tripping toggles do not strike release.	Tripping toggle out of adjustment.	Adjust, operating by hand with power off.
3. Breaker equipped with overload and no-voltage relays will not open.	(a) Same as above. (b) No-voltage coil plunger stuck. (c) Plunger out of adjustment.	(a) Same as above. (b) Overheating of coil. Plunger bent. (c) Adjustment nuts shifted.	(a) Same as above. (b) Replace no-voltage coil. Straighten plunger. (c) Adjust plunger.

(Continued on next page)

DATA SHEET

Troubles of Air Circuit Breakers

(Continued from preceding page)

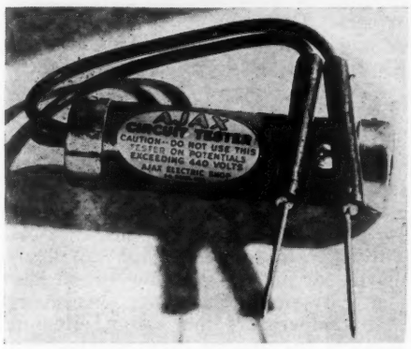
SYMPTOM	TROUBLE	CAUSE	REMEDY
4. Motors hum but will not operate when breaker is closed.	Single-phase operation.	(a) One arm not making contact. (b) If carbon contacts, one or more may he burned so deeply that they cannot make contact.	(a) Adjust arm and contacts until they close properly. (b) Renew contacts.
5. Other equipment, such as heaters, does not function when breaker is closed.	One arm not making contact.	Same as above.	Same as above.
6. Contacts turn a dark color.	Overheating.	(a) Overload. (b) Contacts do not fit properly.	(a) Reduce load or reinforce contacts. (b) If carbon, adjust so they have greater bearing surface. If laminated copper, see that all laminations fit properly and with the same pressure on stationary contacts.
7. Contacts flash from one to the other.	(a) Barriers broken. (b) Low-resistance path in breaker base.	(a) Rough usage, or breaker closes with too much force. (b) Metallic veins in slate. Carbonized path in other material.	(a) Renew barriers. (b) Install new base. Scrape carbon streaks from material.
AUTOMATIC BREAKERS Nos. 6 and 7, above, apply also to automatic breakers.			
8. Breaker will not close.	Closing-coil circuit open.	(a) Defective start button. (b) Stop button circuit open. (c) Defective closing coil. (d) Closing coil armature obstructed. (e) One or more thermal overload relays open.	(a) Locate and repair. (b) Adjust stop button so that contacts are normally closed. (c) Renew or repair coil. (d) Locate and adjust to close properly. (e) Close thermal overload relays.
9. Breaker closes but does not start equipment.	Single-phase operation or non-operation.	(a) One contact not closing. (b) Contacts burned.	(a) Adjust arm so that breaker closes properly. (b) Renew contacts.
10. Breaker does not open when stop button is depressed.	Stop button circuit defective.	Stop button contacts do not open.	Adjust contacts or button spring.

Prepared by H. E. STAFFORD
Electrical Superintendent, Nipigon Corporation, Nipigon, Ont., Canada

EQUIPMENT NEWS

Circuit Tester

Called Ajax. For checking fuses, determining whether circuits are dead or alive. A.c. or d.c., 110 to 440 volts. Comprises small indicating lamp in heavy fiber case, 1¼ in. in diameter, 4¼ in. long. Degree of brilliance with which



lamp burns indicates roughly voltage of circuit: 110 volts produces dull red glow; 440 volts, full brilliance. Ajax Electric Shop, 1118 East Bowman St., South Bend, Ind.

Switch

Bulletin 9101 Pushbutton Motor Starter, adaptable for fractional horsepower applications. Free-tripping thermal overload mechanism. Pushing "start" button resets overload mechanism and restarts motor. Capacity of switch can be varied by changing heater coil. Silver-to-silver contacts, mechanism removable for wiring, stainless steel springs, top and bottom knockouts. Cutler-Hammer, Inc., 253 N. 12th St., Milwaukee.

Condensate Return Units

For small plants. Three sizes with radiation range of 1,000 to 3,000 sq.ft. although additional sizes up to 12,000 sq.ft. are available. Capacities, 180, 250, and 270 gal. per hr.; condensate, 60 and 90 gal. per hr. Tank of No. 12 gage steel has diameter of 14 in. and height of 22 in. Automatic controller switch, mounted on top and connected to ball float, governs operation of motor and provides overload protection for motor. Motor horsepower, ⅛. Tank and pump mounted on structural steel base. Occupies float area 22x24 in.; over-all height, 29 in. The Decatur Pump Co., Decatur, Ill.

Steam Trap

Combination float and thermostatic type. Entire working mechanism mounted on cover; piping connections on body. Reversible valve and seat are of stainless alloy steel. Deep water seal prevents loss of steam. Limit stop on float lever prevents elevation of float beyond normal. Six capacities. Two models for vertical or 90-deg. inlet connection; one model with horizontal inlet and outlet connections. Called "Adsco Vertical Steam Trap." American District Steam Co., North Tonawanda, N. Y.

Socket Wrenches

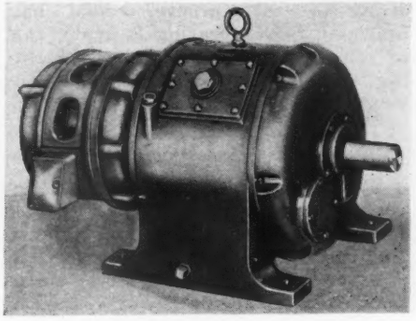
Line of chrome-vanadium steel sockets for detachable-head socket wrenches. All sizes from $\frac{5}{32}$-2½ in. Double-hex and double square sockets included. Chromium plated. Come singly or in matched sets contained in steel cases. Armstrong Bros. Tool Co., Chicago.

Trolley Track

Called "R-W Lock Joint." Rectangular section, with two bottom edges raised upwards into the section to provide runway for hanger wheels, is suspended from side- or center-mounted bracket. Bracket is rectangular-shaped with cutaway section in bottom. Clip bolted into top of bracket extends downward into two slots in track section to prevent slipping of sections. Richards-Wilcox Mfg. Co., Aurora, Ill.

Motors and Speed Reducers

Helical- and worm-gear. Helical-gear motors for drives requiring ¾-75 hp. and speeds down to 6 r.p.m. on slow speed shaft when used with 1,750 r.p.m. motors. Heat-treated chrome-nickel-steel gears. Manufacturer claims that efficiency of double-reduction units is 96 per cent, of triple-reduction units 94 per cent. Worm-gear motors in power capacities ¾-40 hp. with speeds on low speed shaft down to 30 r.p.m., using 1,750 r.p.m. motor. Efficiency of 95 per cent claimed. Worms of high-carbon alloy steel integral with shaft. Anti-friction bearings. Available with any type of motor. Motors supported on reduction unit. Known as "IXL" line. Diehl Mfg. Co., Elizabethport, N. J.

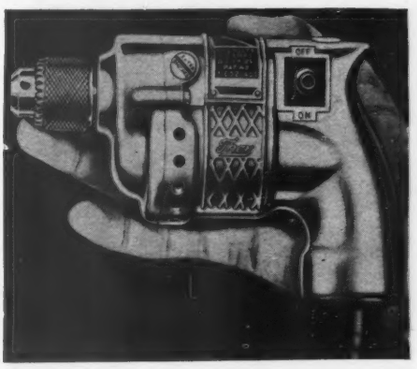


Waste Line Cleaner

For breaking up pipe stoppages. Consists of fifty feet of flexible steel rod wound on a reel and fed through sleeve and flexible nozzle. By setting ratchet pawls on the sleeve, rod is fed into waste line with pumping motion. When elbow or stoppage is reached, a light tension is put on rod which is then revolved until it passes the obstruction. Can be used in lines of one inch and larger diameter. Made of aluminum alloy. Called "Power-Twist." General Appliance Co., 201 Hickory St., Dayton, Ohio.

Drill

Electric. Weighs 2½ lb.; can be operated with one hand. Style U14 has drilling capacity of ¼ in. and free speed



of 2,500 r.p.m. Style U13 has capacity of $\frac{3}{16}$ in. and free speed of 3,750 r.p.m. Both 6¾ in. long. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

Mounting

For speed reducer and Vari-Speed Motor Pulley. Pulley and gear reducer are both mounted on sliding base which is bolted to stationary base. Sliding base can be adjusted to various positions as required by size of reducers. Reeves Pulley Co., Columbus, Ind.

Terminal Lugs

Solderless. For securing wires and cables in sizes from No. 14 to 1,000,000 circ.mil. Five sizes. Made of electrolytic copper. Manufacturer claims that any amount of clamping necessary for good contact can be made without struc-

tural failure. Called "Wire Grips." Bull Dog Electric Products Co., 7610 Jos. Campau Ave., Detroit.

Lighting Fixture

Design 5500 Luminaire. Suitable for low-ceilinged interiors. Opaque type has bowl made wholly of aluminum with special reflecting surface. Three sizes: 200, 500 or 300, and 750-1,500 watt lamps. Luminous type has upper member of bowl made of opal diffusing glass and lower cup or reflector of aluminum. Two sizes: 200 and 500 or 300 watt lamps. Curtis Lighting, Inc., 1123 W. Jackson Blvd., Chicago.

Control

Called "Hydraumatic." Hydraulic automatic control for variable speed transmission. Actuated by indicating lever attached to any element from which indication of required speed can be taken. Lever is connected to shifting lever of transmission through a differential mechanism and vertical and horizontal rods. Movement in lateral direction of indicating lever is transmitted to shifting levers which vary diameter of disks and V-belt, increasing or decreasing speed on variable speed

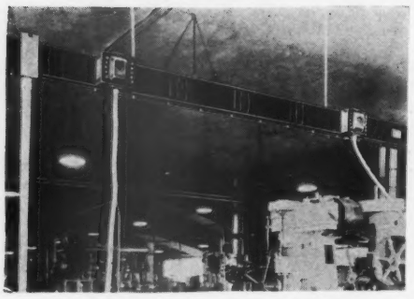
shaft of transmission. Electric motor operates geared oil pump. All operating parts, except driving motor, housed in dustproof cast-iron inclosure. Reeves Pulley Co., Columbus, Ind.

Belt

Rubber-fabric type. Manufacturer claims that it is 100 per cent oil resistant. Flat and V types. L. H. Gilmer Co., Tacony, Philadelphia.

Clutch

Magnetic. Field ring may be rotated and locked in new position to compensate for wear on friction surfaces. Floating magnet armature. Replaceable magnet coil, bronze collector rings, lining wear indicator, pilot bearing. Cutler-Hammer, Inc., 253 N. 12th St., Milwaukee.



Electrical Distributor

Called "BUStribution." Steel duct in 10-ft. sections incloses busbars mounted on high voltage insulators. Can be assembled in vertical or horizontal runs of any length or contour. Two types of sections. "Busduct" or main feeder runs and "Plug-in Duct" sections having regularly spaced covered openings for attachment of branch circuit plug-in devices. Switch-and-fuse or circuit-breaker circuits may be mixed on same run. Bull Dog Electric Products Co., 7610 Jos. Campau Ave., Detroit.

Bonded Plywood

Called "DURE z WOOD." Plywood and veneered sheets bonded with phenolic resin. Guaranteed by manufacturer to be water- and termite-proof. Large lightweight sheets. Suitable, with various surfacing treatments, for indoor or outdoor use. General Plastics, Inc., North Tonawanda, N. Y.

Caster

Drop forged steel. Top plate and king bolt are one piece. Plate is ½-in. thick; bolt is 1 in. in diameter. Ball bearings. Wheel fitted with roller bearing turning over 1-in. steel axle. Wheels of metal, Textolite, or metal with rubber tire. Wheel diameters, 5-10 in. The Service Caster & Truck Co., Albion, Mich.

Motor

Vertical slipring. Fan-cooled with fan located on shaft extension at top, opposite driving end. Sliprings at bottom with dust-tight covers and outlet for cooling air. Rated at 75 hp., 690 r.p.m., 208 volts, 3-phase, 60 cycles, for continuous duty with 55-deg. temperature rise. Thrust load taken at top by double-row, deep-groove, radial ball bearing. Lower bearing is double-row of self-aligning type. Welded mounting base. Harnischfeger Corp., Milwaukee.

Air Filter

Known as Model 40-A Airgard. Includes variable speed motor, double blower-type fans, filter, and cabinet. Can be installed in any sliding window. "Finger-tip" damper control makes possible exact regulation of volume of incoming air. Replaceable filter has 14 sq.ft. of surface. Indoor air may be recirculated. Wood cabinet finished in walnut or ivory. American Air Filter Co., Inc., Louisville, Ky.

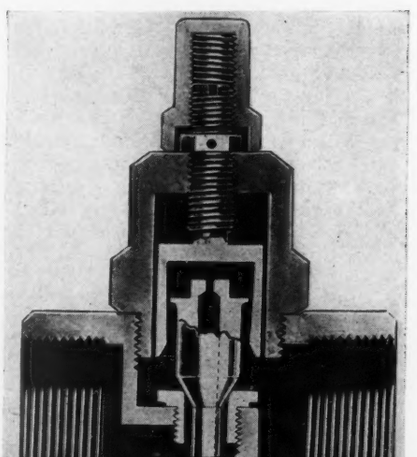
Contactors

Called "De-ion"; 100 and 150 amp. Provide rolling and sliding contact on closing with high contact pressure. Shields confine arc flame. Jarring or bumping will not cause accidental closing. May be connected from front or back. Can be mounted on steel base or any standard panel. Westinghouse Electric & Mfg. Co. East Pittsburgh.

Sealing Compound

For sealing leakages of gases, vapors, and liquids. Manufacturer claims that it is indestructible, will not harden, dissolve, shrink, crack, crumble. Three densities—Lightweight for finely machined joints, gasoline lines, rust and corrosion prevention, emergency high temperature lubrication; Medium Weight for gasket use, water-pump packing filler, rubber-hose connections; Heavyweight for heavy gasket use, calking, eliminating squeaks between wood and metal joints. Called "Tite-seal." The Fostoria Pressed Steel Corp., Fostoria, Ohio.

Steam Trap



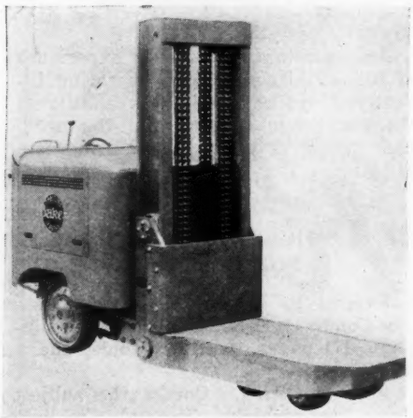
Called "Yarway Impulse Steam Trap." Valve disk is only moving part. Movement of disk is governed by variations in pressure in control chamber above piston. Body of cold-rolled steel, working parts of monel, bonnet and cap of brass. Applicable to all pressures 0-400 lb. Six sizes, ½-2 in. Yarnall-Waring Co., Chestnut Hill, Philadelphia.

Pulleys

Line of pulleys of semi-steel con-

struction for cog-belt drive. For all ratings up to 15 hp. Balanced to insure true-running drive. Machined surfaces. The Dayton Rubber Mfg. Co., Dayton, Ohio.

Truck



Called "5-Ton Hylift." Hoist unit is quadruple-reduction spur gear unit with gears of heat-treated alloy steel and shafts mounted in ball or roller bearings. Cut-out control switches protect platform at top and bottom of its run. Uprights of 10-in. cast alloy-steel channels with 1¼-in. web and flanges. Platform of 1¼-in. high carbon steel lift-arms and carriage welded to diamond-pattern platform plate. Two double, alloy-steel roller chains with 9.2 factor of safety. Main frame of ½-in. steel plate. Underframe of two 1¼x5 in. and two ¾x5 in. steel plates. Both travel and hoist motors have overload capacity of 300 per cent of rated load for 30 minutes. Furnished in any height of lift or platform length. Baker-Raulang Co., Cleveland.

Controllers

Air-operated. Complete line of recording and indicating controllers for temperature, flow, pressure, and liquid level. "Air-o-Line" has 1-150 per cent throttling range and automatic reset; corrects for magnitude, rate, and direction of departure from control point. Throttling range and automatic reset can be adjusted with screwdriver without interruption to automatic control. Indicating and recording thermometer-type temperature controllers available for temperatures within —40 and +1,200 deg. F.; potentiometer-type for —300 to +3,400 deg. F. Flow controllers and liquid level controllers in inductance bridge and mechanical types. Indicating and recording pressure controllers from 30 in. vacuum to 3,000 lb. per sq.in. "Full Throttler" controller has 1-150 per cent throttling range and manual reset. "Throttler" has 1-10 per cent throttling range and manual reset. "On-Off Controller" is designed for two-position service. Brown Instrument Co., Wayne and Roberts Ave., Philadelphia.

Thermometer

For determination of temperature in open and closed motors, bearings, compressors, pumps, etc. Dial plate mounted in dustproof aluminum case, protected by non-breakable crystal and chromium-plated cap. Temperature reading from 0-100 deg. C. Base has threaded stud that screws into case and is attached to machine frame with escutcheon pins. Rubber ring fits tightly against machine keeping outside temperature fluctuations from interfering. Can be installed as permanent heat indicator or used for portable testing. Called "Ideal Tel-Temp." Ideal Commutator Dresser Co., Sycamore, Ill.

Gas Pressure Regulator

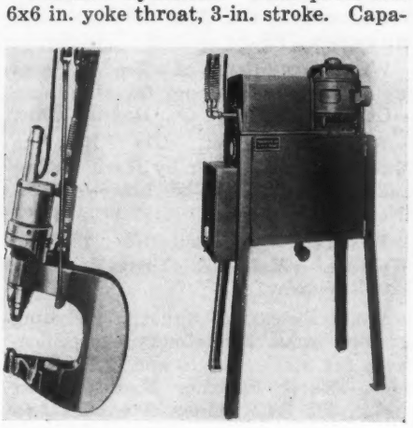
Consists of main and pilot valves. Pressure-balance unit. Operated by air or dry gas piped through pilot valve to top of main valve diaphragm. Pilot set at pressure slightly lower than that to be controlled. Controlled gas piped to lower diaphragm chamber. Manufacturer claims valve suitable for inlet pressures up to 100 lb.; will maintain combustion pressures from 4 oz. to 35 lb. Two kinds of pilot valves: one for mounting on regulator, one for panel mounting and remote control. Sizes, ½-6 in. The McAlear Mfg. Co., 1901-09 S. Western Ave., Chicago.

Condensate Return Units

Ratings from 2,000-40,000 sq.ft. of radiation. Maximum space requirement for 2,000 sq.ft. size is 21x32x28 in., for 40,000 sq.ft. size 24x57x38 in. Automatic float switch. Pump capacities for 54 sizes range from 3-60 gal. per min.; storage tank capacities from 22-98 gal.; discharge pressures vary from 10-40 lb. per sq.in. Single- or multi-stage centrifugal pump. Mounted on steel base plate. Standard motors: single phase, 60 cycles, 110-220 volts; three phase, 60 cycles, 220 or 440 volts; d.c., 115 or 230 volts. Worthington Pump and Machinery Corp., Harrison, N. J.

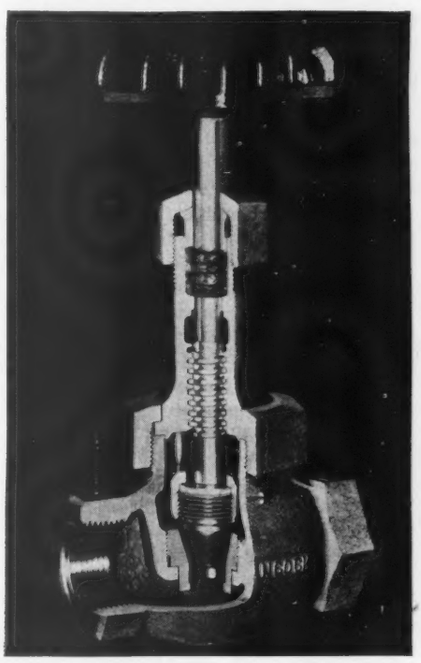
Riveter

Portable hydraulic. Yoke press has 6x6 in. yoke throat, 3-in. stroke. Capacity, ⅜-in. cold iron rivets; maximum pressure, 35,000 lb. Hydraulic-pressure generator with automatic valve and oil pump control. Working pressure, 5,000 lb. per sq. in.; motor, 2 hp. Dimensions 32x17x56 in. Complete automatic riveting cycle controlled by single push-button. No repeat without pressing control button. Instant safety stop. Hannifin Mfg. Co., 621-31 S. Kolmar Ave., Chicago.



Valve

Bronze. In globe and angle patterns. Stainless steel disks and seat rings hardened to Brinell No. 500. Can be repacked while under pressure. For steam pressures up to 300 lb. The Hancock Valve Co., 19 Elias St., Bridgeport, Conn.



Steel Pipe

Line of steel pipe is to be manufactured to supplement complete line of wrought iron pipe. A. M. Byers Co., Clark Bldg., Pittsburgh.

TRADE LITERATURE

ACID EJECTOR — Folder, announcing device for ejecting acid from carboys. —The Lea Mfg. Co., Waterbury, Conn.

ALLOY SHEET STEEL—Reprint, title "Alloy Sheet Steel (Copper-Nickel-Molybdenum)."—Republic Steel Corp., Massillon, Ohio.

BELT DRIVES—Catalog, on selection and design of V-belt drives. — The Gates Rubber Co., Denver.

BELTING — Folder, showing Condor Endless Whipcord Belt. — The Man-

hattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.

CAST IRON—Data sheets on nickel-alloy cast iron.—The International Nickel Co., Inc., 67 Wall St., New York.

CONDENSERS — Bulletin W-200-B2A, on surface condensers with folded tube-layer arrangement. — Worthington Pump and Machinery Corp., Harrison, N. J.

CONDENSATE RETURN UNIT—Bulletin No. 105, on Burks return unit for small plants.—The Decatur Pump Co., Decatur, Ill.

CONDENSATE RETURN UNIT—Bulletin W-321-B6, on types D and G monobloc return units with single- and multi-stage centrifugal pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

CONVEYORS—Section No. 107 of General Catalog No. 100, on screw or spiral conveyor machinery. — Palmer-Bee Co., Detroit.

CRANES — Pamphlet, on traveling cranes for paper handling.—Whiting Corp., Harvey, Ill.

DIESEL ENGINES—Bulletin, showing Type-GA single- and twin-cylinder, horizontal diesel engines.—The Cooper-Bessemer Corp., Mount Vernon, Ohio.

DRILL—Folder, announcing small electric drill for one-hand operation.—Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.

ELECTROPLATING — Booklet, title "Methods and Equipment for Electroplating."—U. S. Galvanizing & Plating Equipment Corp., 27-41 Heyward St., Brooklyn, N. Y.

GYPSUM PLANKS—Catalog, on Gypsteel Plank, a planking made of gypsum.—Structural Gypsum Division of American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York.

INSULATION TESTING — Bulletin No. 400, showing Standco insulation testing sets.—Herman H. Sticht & Co., 27 Park Place, New York.

LIGHTS — Bulletin No. 802, showing complete line of reflectors and lights. — Appleton Electric Co., 1701-1709 Wellington Ave., Chicago.

MIXERS — Folder, showing line of mixers. — The Patterson Foundry & Machine Co., East Liverpool, Ohio.

PAINTING PRIMER—Folder, describing Bar-Ox "Formula 97," a rust-penetrating primer over which paint is applied.—The Truscon Laboratories, Detroit.

PULLEYS—Catalog No. 110-C, on Day-Steel pulleys and Cog-Belt drives.—The Dayton Rubber Mfg. Co., Dayton, Ohio.

PUMP—Bulletin W-316-B3, on vertical Freflo sewage and drainage pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

PUMPS—Three bulletins: W-103-B1, on type PC, horizontal duplex piston pumps; W-317-B4, on type F, single-stage volute, vertical centrifugal pumps; W-450-B22, on No. 5 sump pump.—Worthington Pump and Machinery Corp., Harrison, N. J.

REFLECTORS—Catalog sheets, covering several types of reflectors for mercury vapor lamps.—The Miller Co., Meriden, Conn.

SPRAY PAINTING—Catalog, on spray painting equipment.—Binks Mfg. Co., 3114 Carroll Ave., Chicago.

STEAM TRAP—Folder, announcing Yarway impulse steam trap.—Yarnall-Waring Co., Chestnut Hill, Philadelphia.

THERMOMETER — Folder, showing Ideal Tel-Temp, a dial thermometer for use on machines in danger of overheating.—Ideal Commutator Dresser Co., Sycamore, Ill.

THREADING MACHINE — Folder, announcing "Little Landis" pipe-threading and cutting machine.—Landis Machine Co., Waynesboro, Pa.

TIME CONTROLS — Catalog T-C, on time control of operations and processes. — Automatic Temperature Control Co., Logan and Wilhyelm Sts., Philadelphia.

TIRES—Folder, on pneumatic tires for wheelbarrows and industrial trucks.—The B. F. Goodrich Co., Akron.

TOOLS—Catalog No. 105, on machine tools.—Scully-Jones and Co., 1901 S. Rockwell St., Chicago.

TROLLEY TRACK—Folder, on R-W Lock Joint trolley track.—Richards-Wilcox Mfg. Co., Aurora, Ill.

TRUCK—Booklet on 1½-ton truck.—Four Wheel Drive Auto Co., Clintonville, Wis.

TUBING — Circular showing unusual uses for seamless steel tubing.—Summerill Tubing Co., Bridgeport, Montg. Co., Pa.

UNIFORMS — Folder, showing washable uniforms for factories.—Angelica Jacket Co., 1419 Olive St., St. Louis.

VALVES—Catalog No. 21, on line of valves.—The Fairbanks Co., New York.

VALVES—Circular No. 504 on "King-Clip" gate valves.—The Lunkenheimer Co., Cincinnati.

WASH FOUNTAINS — Catalog, on group washing fixtures. — Bradley Washfountain Co., 2203 Michigan St., Milwaukee, Wis.

WASTE LINE CLEANER—Leaflet, showing Power-Twist cleaner for pipe lines.—General Appliance Co., Dayton, Ohio.

WELDING—Booklet, title "How to Make It Wear Longer by Hard Facing and Overlaying."—The Lincoln Electric Co., Cleveland.

WELDING — Booklet, title "Thermit Welding."—Metal & Thermit Corp., 120 Broadway, N. Y.

WOOD FLOORING—Bulletin, including grading rules and standard specifications for maple, beech, and birch floorings.—Maple Flooring Manufacturers Assn., 332 S. Michigan Ave., Chicago.

Books

FINANCIAL INCENTIVES

A Study of Methods for Stimulating Achievement in Industry

National Industrial Conference Board, Inc., 247 Park Avenue, New York. 47 pages. $1.50.

An examination of the experience of industrial concerns in operating incentive plans under the new conditions; the changes necessary, and the probable future of incentives in American industry.

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AIR CONDITIONING FOR COMFORT

Samuel R. Lewis. Keeney Publishing Company, 6 N. Michigan Ave., Chicago. 271 pages, index and folded chart. $2.50.

Second edition. Covers the subject from terminology through cooling, heating, humidifying, dehumidifying, and ventilation for both residences and commercial or factory buildings.

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CONFERENCE MANUAL FOR TRAINING FOREMEN

S. M. Shellow and Glenn R. Harmon, Milwaukee Electric Railway & Light Company. Harper & Brothers, 49 E. 33d St., New York. 192 pages, appendix and index. $2.50.

This book combines an analysis of conference techniques for foreman training with a complete syllabus for a course of 18 conferences. It is the outgrowth of years of successful work in training foremen.

With the accent so strongly on foremen in present-day conditions, this book supplies a much needed guide in the training of these key men for more intelligent relations with the workers.

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On the Calendar

SEPTEMBER

——**November 11.**—California Pacific International Exposition, San Diego. Headquarters, Administration Bldg., Balboa Park, San Diego.

11-20, Machine Tool Show and Congress, Cleveland. Herman H. Lind, general manager, 1220 Guarantee Title Bldg., Cleveland.

18-20, National Industrial Advertisers Association, 1935 convention, Pittsburgh. D. Clinton Grove, general chairman, P. O. Box 1198, Pittsburgh.

30-October 4, National Metal Congress and Exposition, Chicago. Headquarters, 7016 Euclid Ave., Cleveland.

OCTOBER

14-18, Annual Safety Congress and Exposition, Louisville

NOVEMBER

12-15, International Acetylene Association, 36th annual convention, Cleveland. H. F. Reinhard, secretary, 30 E. 42d St., New York.

DECEMBER

2-7, 15th Exposition of Chemical Industries, New York. Headquarters, Grand Central Palace, New York.

Stewart FENCES

KEEP THE "FIRE BUG" away from your property

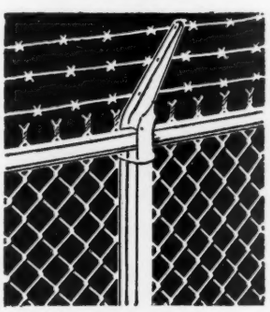
When fire ends with terrific losses to property and damage to equipment, the underlying cause is, quite often, the work of a fire bug, trespasser or vandal who has no business on your property.

Stewart Chain Link Wire Fences insure protection against such fire losses. The cost of fence is but a small fraction of the protective value it affords.

Write for address of Stewart Sales and Erection Office nearest you. Get the "actual sample" demonstration of Stewart construction superiorities.

"The World's Greatest Fence Builders Since 1886."

AGENTS WANTED IN UNALLOTTED TERRITORIES.



Shown is close-up view of our Oval-Back I-Beam line post with integral, tapered (one-piece) extension arm. An unbreakable unit. The heaviest and strongest Chain Link Fence post on the market.

The STEWART IRON WORKS CO., Inc.
105 Stewart Block
Cincinnati, Ohio

A Cost-per-Task Wage Plan

(Continued from editorial page 371)

each operation are estimated. Then we know cost per task for each operation (by its type and class of help). The product of tasks and cost per task gives the cost for each operation. Totaling the cost of each operation gives the cost for the unit of product. Dividing this cost by the tasks in the unit gives the unit cost per task for direct labor. We estimate unit material cost and material cost per task, then cost of tooling up and break this down to tooling-up cost per unit and then tooling-up cost per task. We then estimate the indirect and other controllable expenses and break these down to cost per task.

Finally, when we know what shop or shops the work will be processed in, we get fixed expense per task. However, it must be remembered that we are throwing extra tasks into these shops, and that fixed expense per task will be correspondingly lower. We now total costs per task for labor, material, tooling-up, controllable, and fixed expense, and we have estimated cost per task. Add selling expense and a profit per task and we now have customer's cost per task. Multiplying this by number of tasks in the order, gives customer's total cost.

Bonus Should Be Cumulative

At each inventory period the adjustment for each shop and division should be broken down per task and added to or subtracted from the shop or divisional cost per task, in order to get the true cost per task for past inventory period. This is especially important where an indirect cost-per-task bonus plan is in operation. By padded counts or weights, by not reporting scrap, etc., the cost per task may have been lower than it should have been. The inventory adjustment (write-off) should be charged against future bonus payments, and *vice versa* on a write-up. That is why the bonus plan should be a cumulative one, so that if too much is paid out for any reason it will be corrected at inventory time.

In buying new equipment, the cost per task of such equipment should be figured as an account factor, even

Sounds like poor advice, doesn't it? Yet, almost every steel paint job is a paint-over-rust job. No amount of scraping or wire brushing can clean all the rust off the surface. And the rust that remains, even the specks, is enough to force off any good paint. Rust under a paint film produces more rust, and ruins both the surface and the paint.

With this

NEW TRUSCON PRODUCT

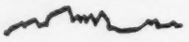
Bar-Ox "Formula 97" was produced in our laboratories to stop the development of rust under a paint film. Even if you can't clean off all the rust (only the loose particles)—be sure to saturate with Bar-Ox "Formula 97"—then paint. Some industries where they formerly had to repaint each month have made a painting last a whole year where the steel was first treated with Bar-Ox "Formula 97."

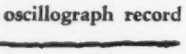
Ask for Truscon Bulletin No. 403, entiled "Paint Over Rust."

THE TRUSCON LABORATORIES
Box 69-A, Milwaukee Jct. P.O. Detroit, Mich.

THE ARC THAT SHOWS UP IN THE SHOW DOWN

You'll find out more about arc welder performance from the oscillograph record than you can learn otherwise in a month of Sundays.

When it looks like this: 
you have the varying heat intensity that means lack of uniform strength in welds.

P&H-Hansen's oscillograph record looks like this: 
That's why you weld faster, more effectively with P&H-Hansens. They make welding easier, reduce the dependence on human skill.

Before you buy your next welder, examine comparative oscillograph recordings. You will find the key to strong dependable welds.

HARNISCHFEGER CORPORATION
4525 W. National Ave., Milwaukee, Wis.

Bulletin HW-4 gives you "The Inside Story". Ask for it.

Models range from 50 to 800 ampere capacity.

Hope We'll See You
BOOTH 504
Exhibit Hall
Machine Tool Show

though it is an asset. For instance, if a new machine is to cost $15,000, and the annual saving in direct labor is $5,000, then the write-off period will be three years, and each week for the shop concerned will appear the item, "equipment cost, $100." This, divided by the number of tasks for that week, will give the equipment cost per task.

When, at the end of three years, the $15,000 has been charged against the shop, the $100 equipment cost per week will disappear, the machine has been paid for, and savings per task are increased by that much. In other words, the new equipment cost is not forgotten as soon as purchased, simply because it is an asset. Every possible expenditure should appear in the cost-per-task analysis.

Many times, purchase of new equipment in one shop will benefit a second shop, through no efforts of its own. In this case, the benefits should accrue to the shop that has made the necessary expenditure, without which the second shop could not have lowered its cost per task. Or, where two shops are to benefit jointly, the equipment cost per task can be written off by both shops proportionally to the savings of each. The above holds true also when a new system is being installed in office or factory. The cost of system per task can be written off against participating shops and departments, based on time period as for new equipment.

Maintenance Can Add to Profit

(Continued from editorial page 392)

bination of metering services. Two or more plant buildings, independently served with electrical energy through separate meters, usually pay at rates determined by the individual current consumption. If the metering service is combined, the combination demand load may be less and the over-all current rates drop, due to the greater consumption of current through one meter and the lessened cost of current when larger amounts are used.

Each of the items discussed above represents a comparatively small saving; nevertheless, the aggregate is considerable. Possibility of making savings by paying attention to such details represents one of the important phases of maintenance.

MORE THAN 45 YEARS ON THE JOB
... the first one we ever built!

It's the first of its kind ever completely built in the Harnischfeger shops where the trimotored electric crane was pioneered. 45 years on the job and still going strong!

Since then we've learned a heap about building cranes to meet the demands of American industry. You can't find a crane problem that P&H engineers haven't already licked. That's why, as America's foremost builder, P&H has the experience and facilities to give you what you need . . . when you need it.

HARNISCHFEGER CORPORATION
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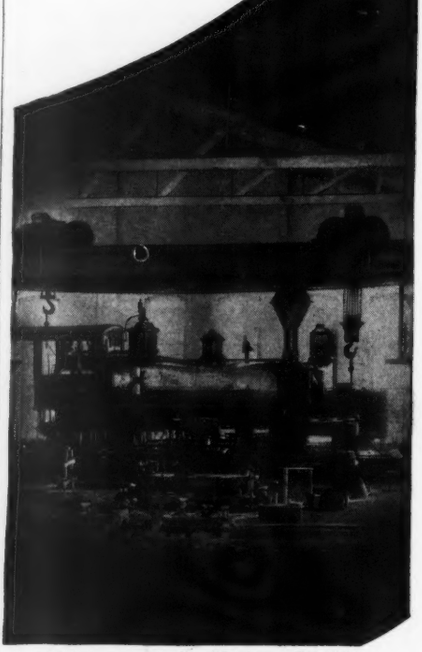
Catalog 450 tells the story of P&H Crane Construction. Write for it.



40-ton crane in Union Pacific Shops at Cheyenne; built in 1890.

Hope We'll See You
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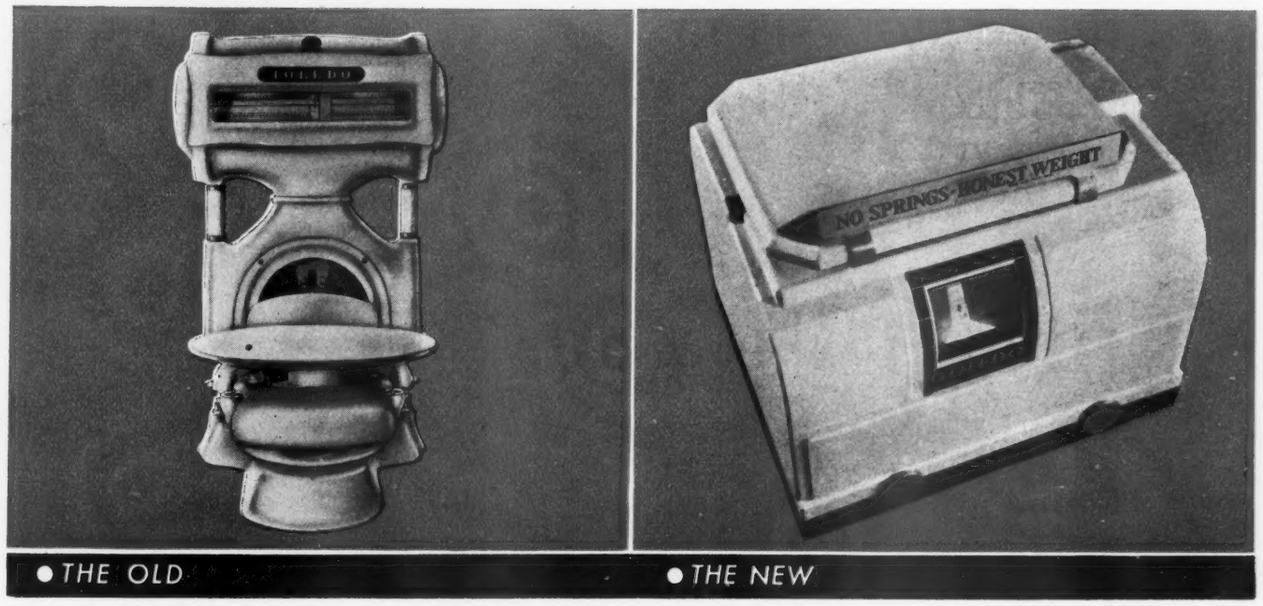
Exhibit Hall
Machine Tool Show



TOLEDO SCALE PIONEERS AGAIN!

★ THE TOLEDO PLASKON DUPLEX SCALE is the new, great achievement that the Toledo Scale Company announces this month. The Toledo Printweigh Scale was developed for all the manufacturing industries two years ago. Now that company revolutionizes the store scale—carries its research efforts further into industry. Cooperating in the development of the new scale were The General Electric Company . . . The Aluminum Company of America . . . The Bausch and Lomb Optical Company . . . and Toledo Synthetic Products, Inc.

★ THE TOLEDO PLASKON DUPLEX SCALE represents, in turn, the most important development of PLASKON—MOLDED COLOR. Its colorful, sanitary housing is molded of PLASKON . . . is the largest plastic molding ever made . . . required the construction of the largest plastic molding press in America. The new scale weighs 67% less than the old . . . occupies 63% less space . . . cuts material costs . . . and manufacturing costs. PLASKON is perhaps the greatest single reason for these economies.

★ Consider the industrial significance of the Scale . . . of the body material, PLASKON. Consider what the development may mean to your company. Write today for the booklet explaining in detail the story of research, of new material, new uses, and new opportunities in unit manufacturing costs.

TOLEDO SYNTHETIC PRODUCTS INCORPORATED

TOLEDO • OHIO

★ PLASKON ★

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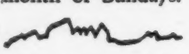
When it looks like this: 
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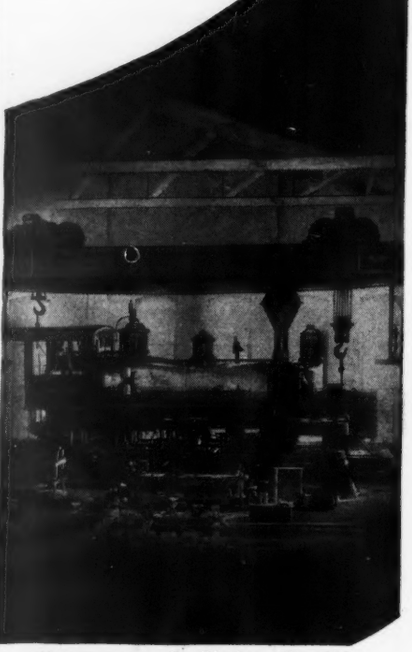

40-ton crane in Union Pacific Shops at Cheyenne; built in 1890.

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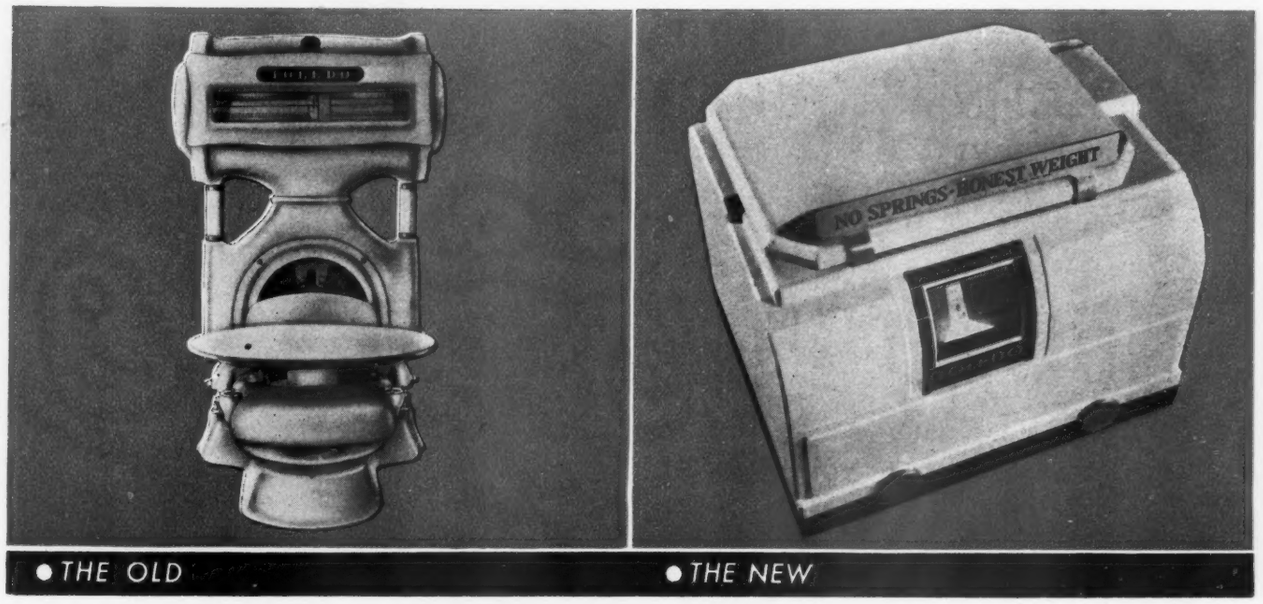

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TOLEDO SYNTHETIC PRODUCTS INCORPORATED

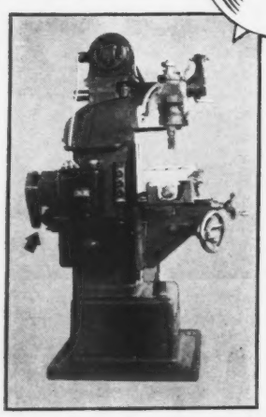
TOLEDO • OHIO

★ PLASKON ★

MOLDED COLOR

THE SWING IS TO ROLLER CHAIN...

No. 12 Van Norman milling machine employs direct roller chain drive for added reliability.



This free catalog and data book should be in your files,—is it?

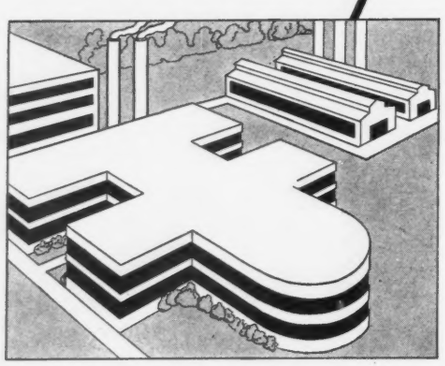
Roller Chain combines efficiency, positiveness, long life, moderate first cost and negligible upkeep expense to a greater degree than any other drive.

Appreciation of these has caused a pronounced "swing to chain," among Machine Tool builders.

Baldwin-Duckworth machine finished roller chain meets the most exacting machine tool and machinery requirements. It costs you nothing to consult a Baldwin-Duckworth engineer. Why not do so? Address Baldwin-Duckworth Chain Corporation, Springfield, Mass.

BALDWIN-DUCKWORTH

Make your plant



LOOK WORTHY OF YOUR *product*

No single thing you can do will improve the appearance of your plant as much as painting. There is no paint that will look better and cost less per square-foot-year than Dixon's Silica Graphite or Dixon's Bright Aluminum Paints.

DIXON'S BRIGHT ALUMINUM PAINT
For eye-appeal without, for eye-ease within, for protection everywhere. Beautifies the structure, illumines the interior. Non-tarnishing, unaffected by weather or fumes. Equally effective on metal, wood, concrete, plaster.

DIXON'S SILICA GRAPHITE PAINT
The water-repellant, natural flake graphite and silica in pure boiled linseed oil, produce a coating impervious to weather and fumes. Wide coverage, unmatched paint-life.

DIXON'S MASTER SPECIFICATION NO. BI-44 ON REQUEST

JOSEPH DIXON CRUCIBLE CO. D X N TRADE MARK Jersey City, N. J. *Established 1827*

DIXON'S Bright **ALUMINUM PAINT**

5286

What Fatigue Does to Output

(Continued from editorial page 383)

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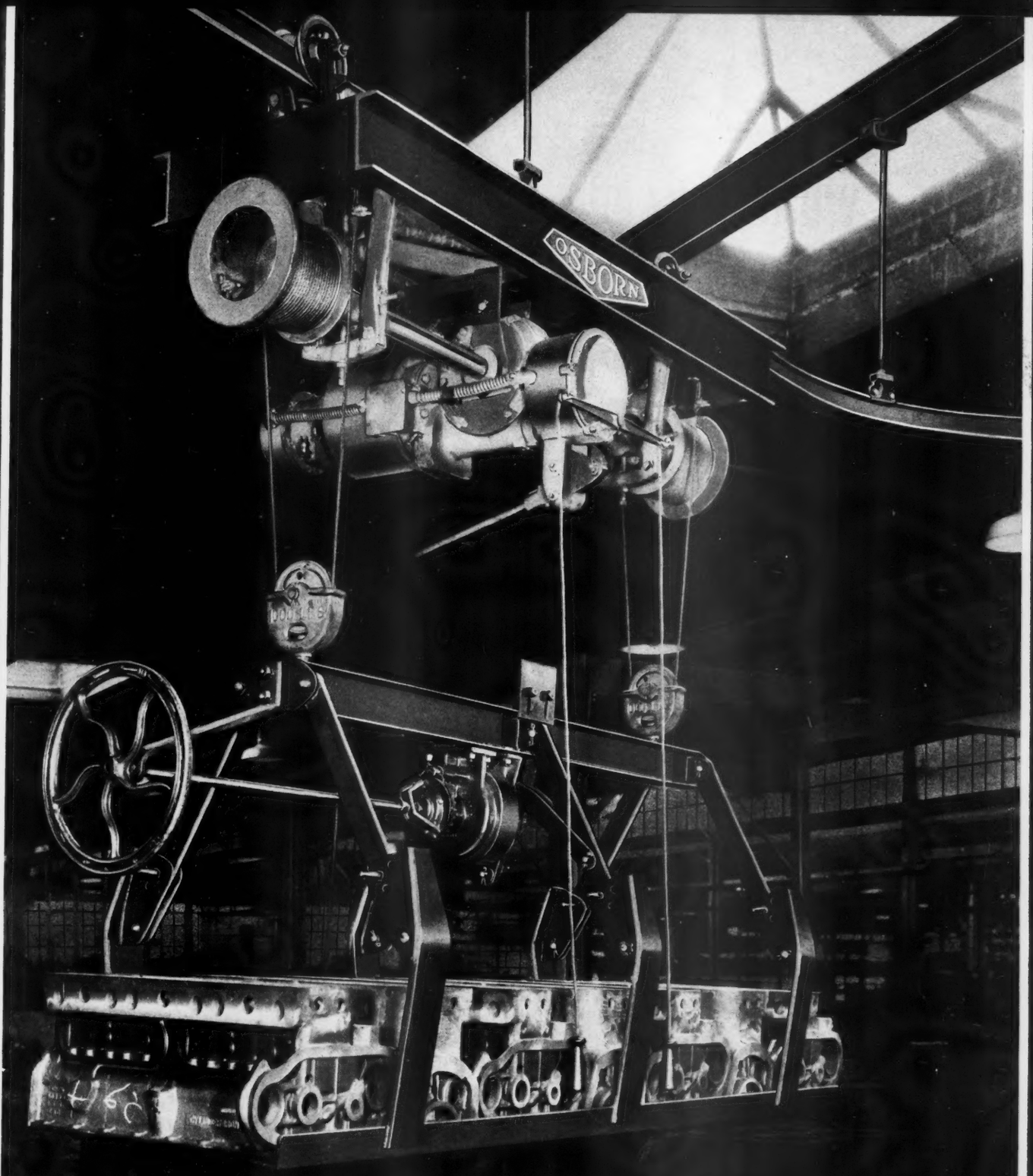
strong, and if the worker is asked from time to time if he is beginning to feel tired, it is most likely that he will answer yes in all good faith and work more slowly. Hence the most dependable fatigue studies will be obtained if the operator does not know exactly what the observer is looking for, provided only that he has faith enough in the observer to believe that the results of his study will not affect him harmfully.

A Fatigue Allowance

It has been pointed out how individuals vary in their characteristics and in their reactions to fatigue. Similarly, they differ in their working habits. Some like to work in short bursts of speed. Others like to work uninterruptedly for longer periods. The most satisfactory way devised up to the present time for handling the problem of fatigue allowances and rest periods seems to be to add a percentage allowance to all time values in recognition of the fatigue element and then to allow the operator to arrange his rest periods to suit himself. Those who are incapable of sustained effort will interrupt their work frequently to go for a drink of water or to the washroom. Those who prefer to work over extended periods will leave their work stations infrequently.

The amount that should be allowed to cover fatigue will vary with the nature of the job and the conditions surrounding it. We have found that the best way of arriving at the proper allowances is to take a number of all-day studies in the manner outlined above, then to average all usable results, and finally to establish a fixed percentage for that class of work based upon the results of the studies plus a liberal amount of judgment. The aim should be to fix an allowance that will cover the fatigue experienced on the average. Then a worker who is physically exceptional and who does not need to consume all the time allowed for recuperation can devote it to productive labor and benefit to the extent of his physical or mental superiority —which is an entirely just arrangement.



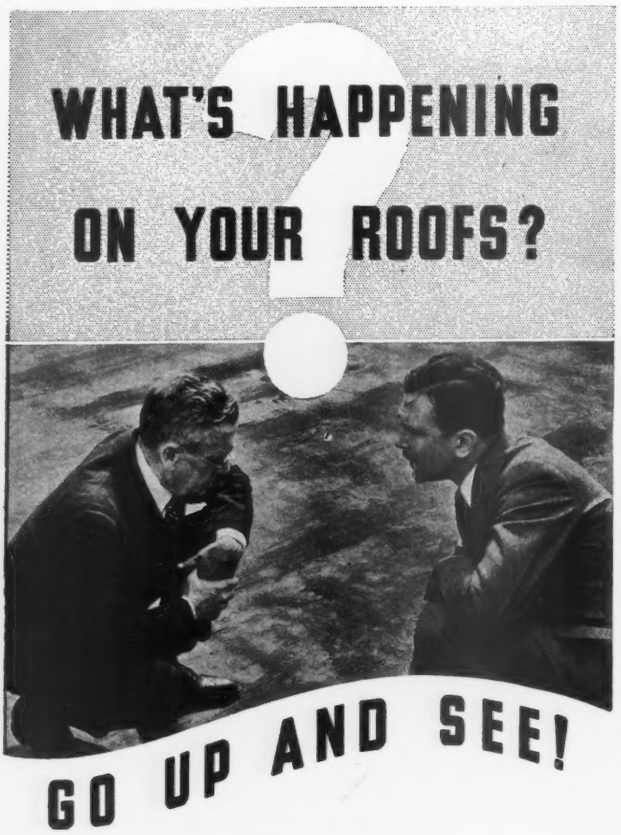
OSBORN

TRAMRAIL SYSTEMS

continue to accumulate earnings long after the equipment has paid for the cost of installation

THE OSBORN MANUFACTURING COMPANY 5401 Hamilton Avenue—Cleveland, Ohio, U. S. A.

Distributors in Principal Cities Are Listed in the Telephone Directory Under "Osborn Tramrail Systems"



Plenty of things are happening to thousands of roofs right now. Leaks . . . deterioration . . . damage to the insulation . . . gradual decay or disintegration of the roof deck.

Maintenance work . . . put off since 1929 . . . has proven very costly in roofing. Further putting off of simple roof repairs may mean complete replacement later on.

Go up and see your roof. If there is any damage to the roofing, you should have it repaired or replaced with Koppers Coal Tar Pitch and Tarred Felt to assure long, care-free service. Send coupon for the booklet which explains why.

KOPPERS PRODUCTS COMPANY
KOPPERS BUILDING PITTSBURGH, PA.

KOPPERS

- KOPPERS COAL TAR PITCH
- KOPPERS TAR-SATURATED FELT
- KOPPERS TAR-SATURATED FABRIC

Koppers Products Co., Pittsburgh, Pa. F
Please send me a copy of the Sweet's Reprint showing how to select roofing materials.
Your Name.....
Firm.....
Address.....

Research— a "Case" History

(Continued from editorial page 368)

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Bausch & Lomb will tell you it's an achromatic spherical lens. In addition to doubling the number of prices per pound on the old cylinders, it also shows the figures as clearly through its margins as through its center. Approximately two-power magnification makes the numerals distinct from a distance of several feet. Definition of numerals and scale intervals is sharp, without color or distortion, covering a large flat field of view.

The case? After all, there'd have been no new scale, no story for us to write, if it weren't for the case.

We left the research people trying to mold a Plaskon case bigger than anything ever tried before. A huge new press recently installed at the General Electric plant in Fort Wayne is now producing it successfully. It measures $17\frac{3}{4}$x$14\frac{5}{8}$x$11\frac{1}{8}$ inches, and is significant because the technique employed in molding a part of its unprecedented size is applicable to many other machines and devices.

100 Pounds Lighter

Total weight of the scale is now $55\frac{1}{2}$ pounds—100 pounds lighter than its predecessors—and only $8\frac{1}{2}$ pounds of the total weight is in the case. Cast-iron housings used on previous models weighed from 50 to 75 pounds. Besides contributing so largely to the total reduction in weight, the molding provides a gleaming white exterior surface.

Whatever troubles they'd ever had with the old scales, had always been in finishing. Now there is no finishing. This surface is solid all the way through. Except for the flash that has to be removed, the case you see on the new scale is exactly as it came from the press.

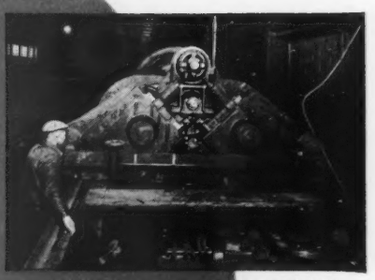
Nobody is saying very much about the technical aspects of this molding process, but to us laymen one point is of especial interest. Since the molding powders are almost pure white, and a single speck of dust in one loading of the compound might spoil a case, extra precautions are taken to prevent that from happening. Press and finishing rooms are well painted and lighted, with provision for flushing and scrubbing.

Also, an air-filter system was de-

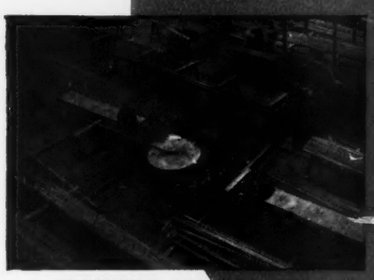
FRICTION SAW

STEEL FOR MAINTENANCE WORK IS A *primary part* of J&L WAREHOUSE SERVICE

SAW CUTTING LARGE ROUND



TWIN BLADE ANGLE SHEAR



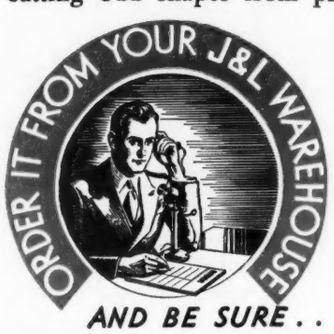
BENDING EQUIPMENT

OXYGRAPH CUTTING MACHINE

PLATE SHEAR

TRAVELING CRANE

Large and complete assortments of steel products are carried in **J&L** Warehouses, and modern cutting, bending, forming and welding equipment enable us to supply them in the sizes and shapes you need and in the forms most suitable for your use. A few of the operations which we are frequently called upon to perform are: forming, machining and milling bars; cutting odd shapes from plates to replace broken castings and forgings; die punching and shearing to accurate dimensions; assembling steel plates and shapes to fit your requirements by riveting, bolting and welding. Whatever your needs for steel, or for the working of it, call on the **J&L** Warehouse nearest you. Highly important, too, is our ability to ship, almost invariably, well under 24 hours. Write for a copy of the **J&L** Warehouse Stock List.



AND BE SURE . .

JONES & LAUGHLIN STEEL CORPORATION
AMERICAN IRON AND STEEL WORKS
JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

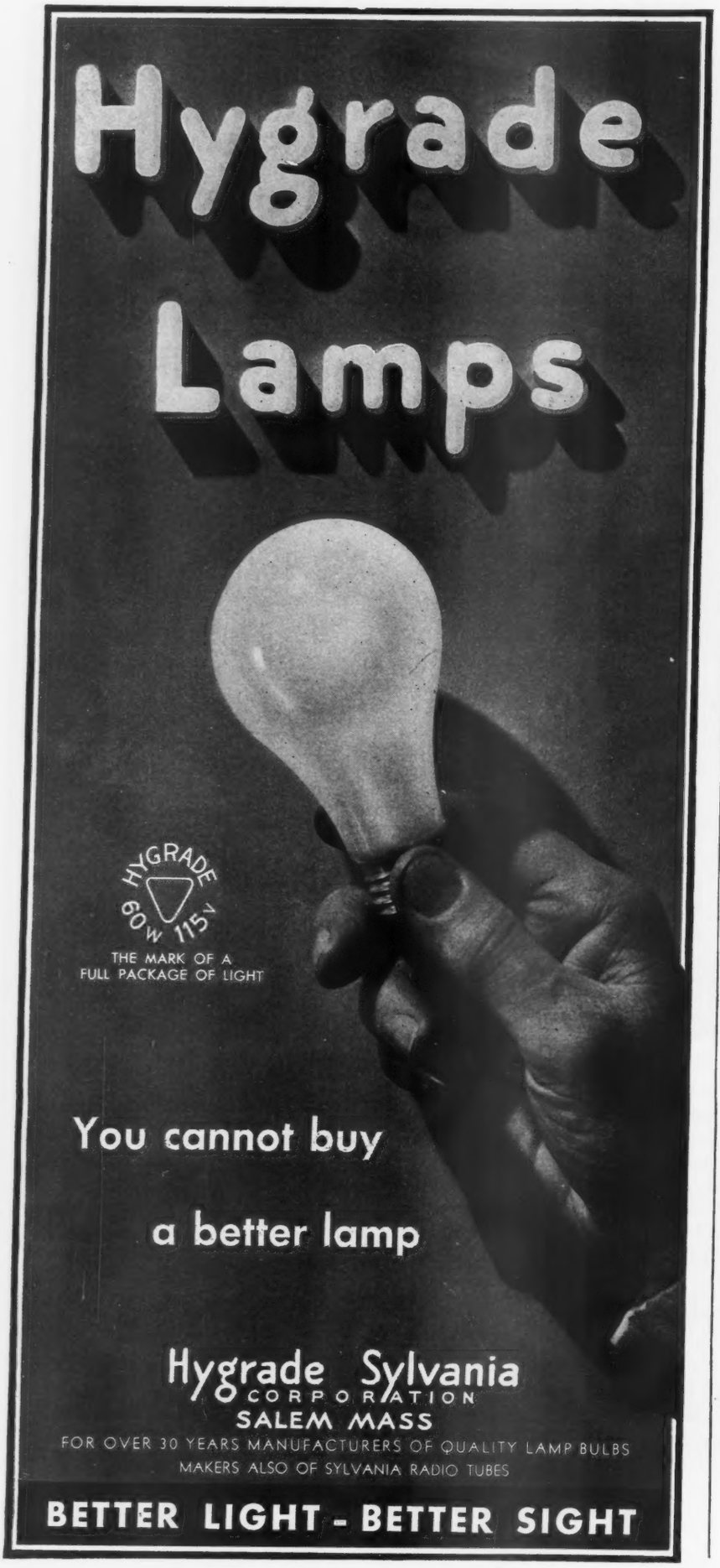
J&L STEEL

J&L WAREHOUSES

CHICAGO	CINCINNATI	DETROIT	NEW ORLEANS	PITTSBURGH
Virginia 1600	Main 2324	Plaza 0470	Franklin 1131	Hemlock 1000

LOUISVILLE—Magnolia 1693 . . . Stock of Bars for Concrete Reinforcement and Bar Fabricating Yard

MEMPHIS—6-4836 . . . Distributing Warehouse for Pipe, Sheets, Spikes and Wire Products. Reinforcing Bar Warehouse and Fabricating Shop



signed to provide an abundance of clean air, free from contamination. From a tank with glass-wool filters, down in the basement under the press room, the air is discharged through an air-supply duct that has openings so designed that they prevent turbulence and resultant scattering of the compound. The press room is air-tight, moreover, and a slight pressure is built up to prevent infiltration of unfiltered air when the door is opened.

Which is the story Hugh Bennett told us. The new scale confirms his words. It's far and away better than any scale Toledo ever made before—better looking, better acting. Every part of it represents pioneering in new methods. It is the result of the collaborative efforts of six laboratories, all focusing their research and engineering on one concern's product. It represents one of the most thorough jobs of research in the history of American industry. It opens new and broader fields for synthetic plastics. Everywhere in the experience is the implication that if six research organizations can turn to and so completely upset the inhibitions of scale design, there is simply no limit to what applied research might do to any number of products that haven't been around long enough to pick up the weight of tradition which so often impedes our progress toward better and more useful things.

Put Costs Up to the Foreman

(*Continued from editorial page 378*)

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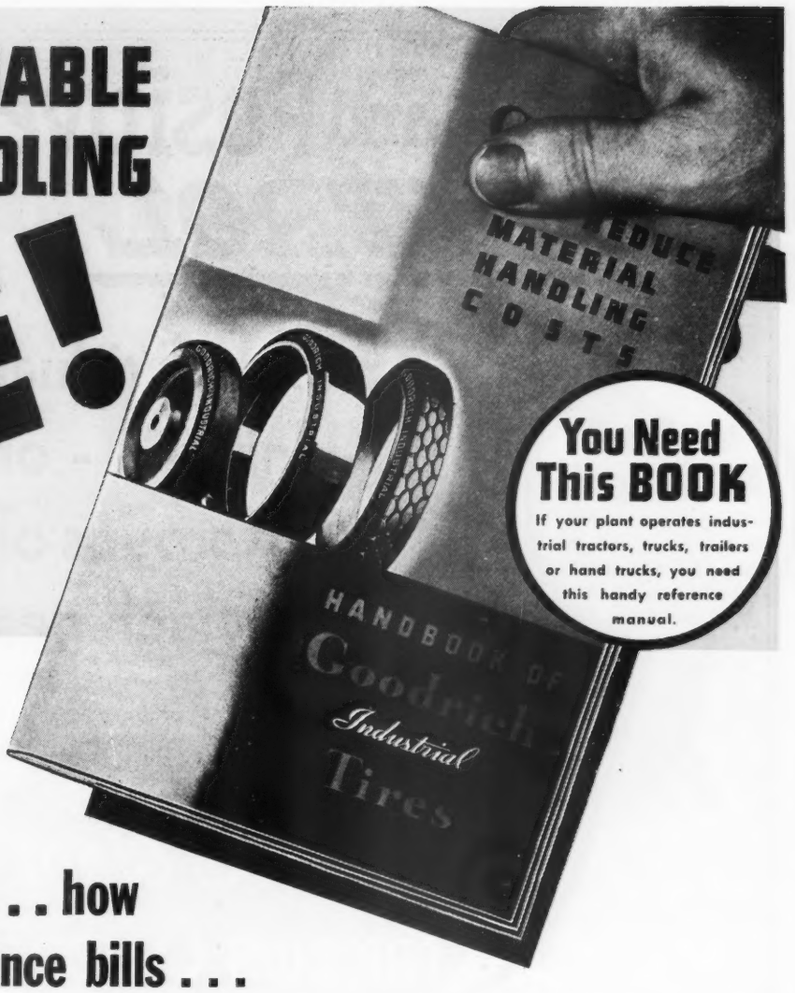
for each rate of operations can be provided. For instance, in the above case the sheet might make provision for showing the expenses for volumes from 50 to 100 per cent in the steps of every 5 per cent of capacity. Such a sheet when completed might look like that shown in the accompanying figure.

Administration of the Control

With a copy of this guide in his possession, and with a greater knowledge of the financial side of his operations as a result of the study made necessary to compile these data, the foreman knows in advance what effect on his expenses any change in operating volumes

GET THIS VALUABLE MATERIAL HANDLING BOOK FREE!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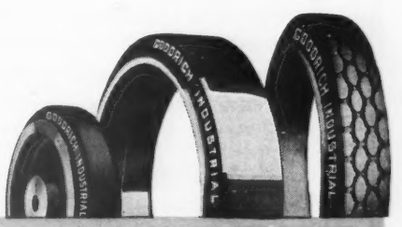

Goodrich *Industrial* Tires

The B. F. Goodrich Co. Dept. N-23
Akron, Ohio
Gentlemen: Please send me a free copy of your new handbook on Goodrich Industrial Tires.

Name _____

Company _____

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Instant and Positive CONTROL

-of Individual Units - - - or Groups of Machines

The Wood's "Universal Giant" FRICTION CLUTCH

Modern manufacturers run their plant with as little waste of power as possible —to have power where and when it is required, with instant control.

The Wood's Universal Giant FRICTION CLUTCH is a time-tried and proven means of connecting or disconnecting a machine (or group of machines) at the will of an operator. It lowers overhead and production costs and gives long, trouble-free service.

Today's conditions demand the saving of as much power as possible, and the "U.G." Friction Clutch is one answer to the problem.

Ask for literature.

WOOD'S PRODUCTS
Shafting, Hangers, Collars, Pulleys, Friction Clutches, Ball Bearings, Flexible Couplings, Rope Sheaves, Pillow Blocks, Belt Contactors, "V" Belts, "V" Belt Sheaves and complete "V" Belt Drives.

they're all made by Wood's -and backed by 75 years' experience

T. B. WOOD'S SONS CO.
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should have, and can make his plans accordingly.

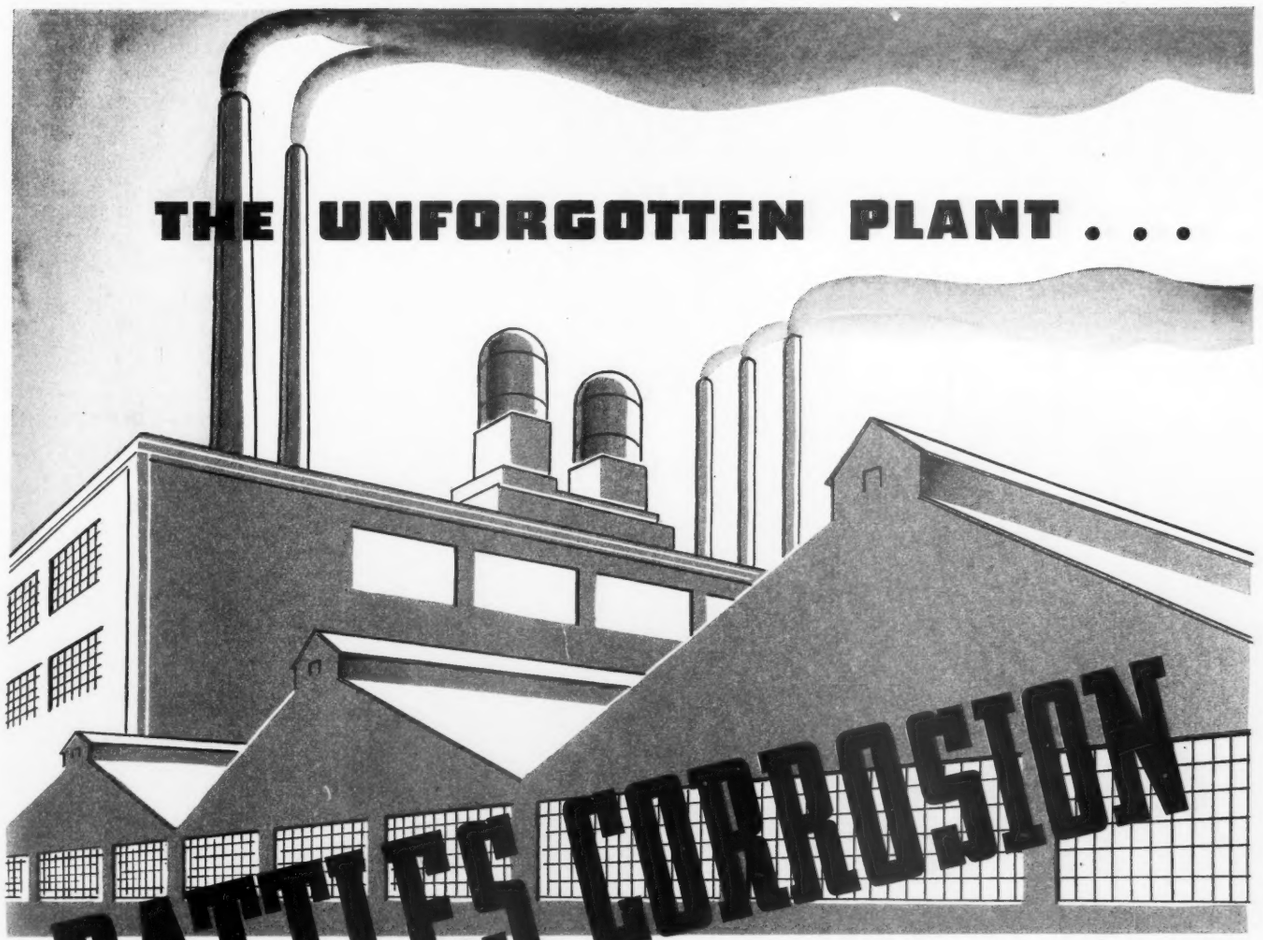
With the completion of the expense control figures, variously known as expense controls, budgets, or standards, the foreman has a guide for the systematic control of his current and future expenses, in the language he understands; he has a compilation of the expected range of his department's production and the expense cost of producing any of the various volumes throughout the expected range. He is therefore expected to use this guide currently when he is approving requisitions for materials, labor, or service work, and knows that if he manages his department effectively the results will not be lost in the poor showing of a neighboring department, for each foreman will be judged by his individual efforts.

Comparisons Are Simple

It is a simple matter to prepare frequently and promptly a comparison for the shop management and the foreman showing the actual volume produced, the expense control for such volume, and the actual expense incurred. Such a report shows not only the comparison of the current period's figures (day, week, or month), but also the cumulative figures for the period to date, as certain maintenance and other expenses are of a periodic nature which may temporarily distort the current figures for any department. Any such temporary distortion is, of course, subject to proper explanation or footnote on the report.

The form of report used for this comparison is so simple and obvious it will not be repeated here. It consists merely of a column showing the expense control figures for the volume worked, and another column for the actual expenses. Variation between the two columns is then shown separately. The same information is also shown for the period to date.

Note that the expense control here outlined is in no sense an "office" report. It is not the function of the office to administer a control of shop operations. The accounting department will, of course, be able to render much valuable service in analyzing the expenses by the most helpful groupings, and in promptly preparing the reports of actual expenditures with the control allowances,



● Some one in America's unforgotten plants has an eye out for capital protection. It's either the top-executive, the plant superintendent, the man who watches the till or all of them together. For most of these plants, both large and small are spic and span with Aluminum Paint.

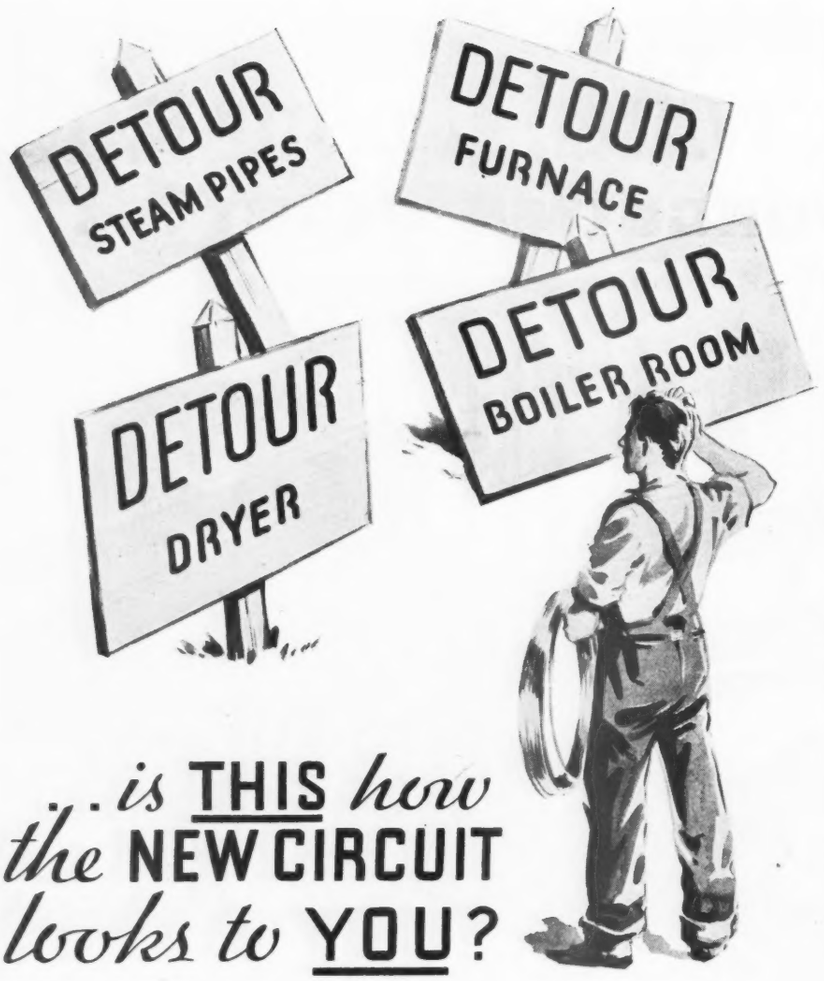
Analyze this situation and you will discover some significant facts. These repeat buyers have found that Aluminum painting is "painting with metal" and that the metal (Aluminum) itself resists corrosion. At the same time it is opaque to sunlight, reflects both heat and light and is unaffected by sulfur-containing fumes. They have discovered two "IFS" that have an important bearing on the results (1) If they buy only quality vehicles specially made for the surface to be covered; (2) If they buy only ALCOA ALBRON Paste or Powder THEY GET ECONOMICAL PROTECTION OF CAPITAL INVESTMENT. And it PAYS!

ALCOA ALUMINUM ALBRON

• • •

Aluminum Company of America does not make paint. But reputable paint manufacturers, their jobbers and dealers sell Aluminum Paint, made with ALCOA ALBRON Paste or Powder and vehicles suitable for various types of surfaces. Be sure the pigment is ALCOA ALBRON and is so designated. Write for booklet, "Aluminum Paint, Its Uses and Application." ALUMINUM COMPANY OF AMERICA, 1826 Gulf Building, Pittsburgh, Pa.

ALCOA ALBRON
PASTE OR POWDER FOR
ALUMINUM PAINT



. . . is THIS *how the* NEW CIRCUIT *looks to* YOU?

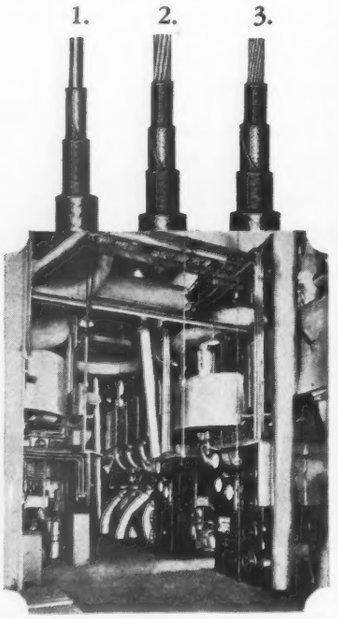
Of course you don't actually *see* those signs in your plant! They are in your experience. You've used ordinary wire so long and you're so well acquainted with its shortcomings that you just naturally shy away from the hot spots without analyzing why!

Just for a change, wouldn't it be a relief to run conduit straight to the point you want to reach regardless of whether the path takes it over a boiler, near a kiln, or alongside a steam header? You can do that. And it's a lot easier than you probably think, too. How? Just use Rockbestos A.V.C. wire. Why? Because this unique wire is insulated—not with a material that is affected by heat—but with a felted and impregnated wall of asbestos reinforced with an embedded insert of varnished cambric, the whole covered with a tough, braided asbestos jacket. (Though lead and armor coverings can be supplied where necessary).

Rockbestos A.V.C. wire and cable is made in all wanted sizes up to 2,000,000 C.M. and for service voltages up to 7,500. Single, duplex and multi-conductor types. Send for our catalog-handbook of these modern heatproof wires and their uses. Try a coil of it on your next job. Saves time, wire and conduit. Rockbestos Products Corporation, New Haven, Conn.

Here is a typical Rockbestos A.V.C. wiring installation. Labor costs are high on jobs like these—it pays to use Rockbestos, the wire with the permanent insulation. Recommended wires are:

1. A.V.C. Boiler Room Wire
2. A.V.C. Power Cable
3. A.V.C. Motor Lead Cable



ROCKBESTOS
—the wire with permanent insulation

but the use of this information must rest with the shop management. The control of plant expenses is just as much a duty of the shop foreman as is the output of his production, and the expense control routine should be "sold" to him on that basis.

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(Continued from editorial page 402)

sary motor current plus an ample allowance for transient peaks. It is customary to set such relays for 110 to 125 per cent of the full-load current. All adjustments for abnormal temperature conditions should be made with the relay exposed to such temperatures.

They should be tested under the same conditions, to make sure that they will trip under sustained overloads with the usual tolerances.

A simpler, perhaps safer, way out is to replace the relay or the heaters with others of the next higher or lower rating, for temperatures that are above or below normal, respectively.

J. L. YOUNG, *St. Marys, Ohio*

Motor Rewound, Speed Low

We are having trouble with a small, universal-type Dumore motor, rated 110 volts, 12,500 r.p.m. The field coils of this motor had to be rewound, and No. 22 s.c.e. wire was used. After rewinding we found that the speed was only 9,400 r.p.m. when the fields were connected in series. The speed could be raised to 11,500 r.p.m. by connecting the fields in parallel, but there was considerable arcing at the commutator. Growler and other tests of the armature have failed to disclose any defects. Can someone tell me the reason for this change in speed? N.K.—Joliet, Ill.

DETAILS of the motor are not given, but there is one type of this make in which it is possible to insert the field core out of its proper position. Since the brushes are fixed on the frame, incorrect positioning of the core has the same effect as shifting the brushes, thus producing poor commutation and decreased speed. I suggest that N.K. try twisting the core in the frame.

It is also possible that the fields have been connected to reverse the direction of rotation of the armature, which can be checked by seeing whether the nuts on the shaft tend to tighten or spin off if held when the motor is running.

Presumably care was taken to make sure that the wire size and number of turns in the field were not changed when the motor was rewound; also that bar-to-bar tests were made on the commutator with a millivoltmeter, to confirm the sometimes unreliable indications of the growler test, or the bar-to-bar test with a telephone receiver, if this were made.

Finally, the field coils should be checked to make sure they are not bucking.

L. A. HUNT, *Toronto, Canada*

FACTORY
MANAGEMENT and MAINTENANCE
L. C. MORROW
Editor

More Power to Management — More Management to Power

BETTER business. More production. Many plant problems solved as a result. Not the power problem, however. It is aggravated. Its importance is increased as volume of business grows.

And just what is the power problem?

Answer: How reduce the existing great wastage of power, estimated at from 25 to 50 per cent of the total that is generated in industry as a whole, plus part of the purchased energy?

Corollaries: How procure power and heat at lowest unit cost? How distribute and utilize power and heat most effectively?

Whose is the responsibility?

Management's. In a period when practically all manufacturing costs are rising, power costs come closer than most others to being *controllable* costs. That condition is management's cue.

What are the waste preventives to be used?

They are many, but their selection depends entirely upon the conditions to be met in specific cases. Selection must be made only after thorough study.

BY WAY of example, consider the case of a Massachusetts paper mill.

This mill used 150-pound steam. A turbine was operated to provide part of the power required. The remainder was purchased.

A considerable sum of money was spent to put in a 415-pound pulverized-coal-burning boiler and to add a bleeder turbine.

Result: Economies that will pay for the new equipment in less than four years and from then on contribute direct to net profit.

Here are some of the details that somebody had to figure out so they would fit the needs of that particular mill. Skip them if you like, but you really shouldn't.

Only two of the several old boilers were thrown out; the others, and the old turbine as well, were kept as reserve units.

To insure continuous operation without duplication of expense, the new turbine was designed to carry full load on 150-pound steam from the old boilers. Provision was made for operation of the old turbine from the new boiler through a pressure-reducing valve whenever emergency conditions so require.

The new turbine is a six-stage, impulse-type machine, with extraction between the first and second stages. Bled steam averages 60 per cent of the total steam generated, is used in various processes, and then is returned to the power plant.

Power load over weekends and holidays is carried by a back-pressure house turbine driving a.c. and d.c. generators.

THAT'S the story of the Massachusetts paper mill. Power costs now are controlled costs and a considerably increased net profit is in sight.

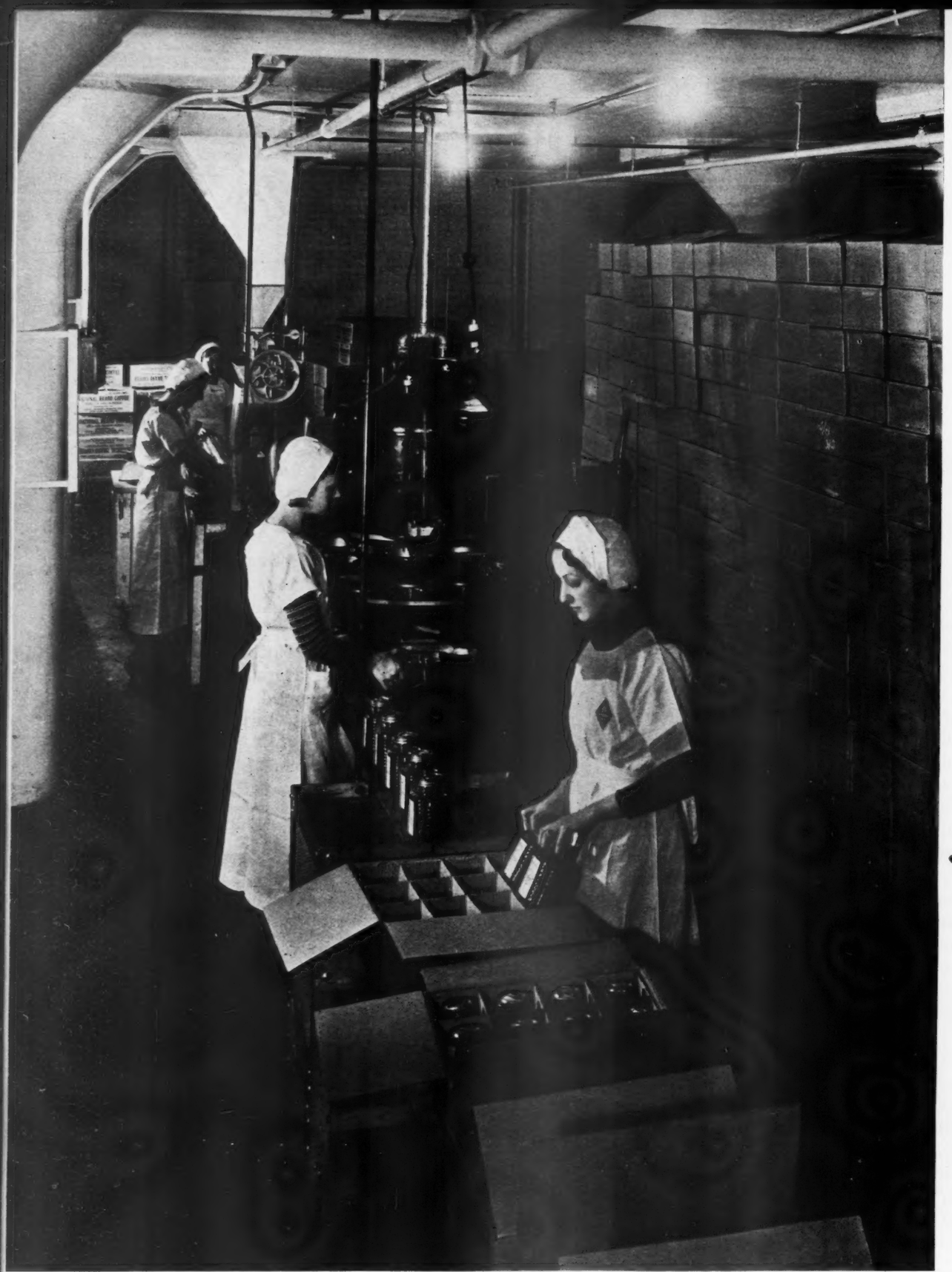
Other plants have done equivalent jobs. But there are many that haven't. Those we're shooting at.

For every day that out-moded, inefficient, inadequate power equipment is kept in operation, a toll is taken out of net profit. Conservatively estimated at $350,000,000 a year, that toll is altogether too much to pay for the privilege of keeping old equipment and old methods in service.

If you've read this far, you're probably assuming that we have something constructive to suggest.

Right. It's the Special Section (sepia paper) in this issue—prepared to help executives and engineers visualize the more important power problems that are common to most plants, initiate the studies that should be made, and plan the changes that are necessary to improve net profit.

From these responsibilities management cannot escape. More power to management. More management to power.



Vacuum packing in glass is National Tea Company's latest move to increase coffee sales

What we are all after in the final analysis is a higher standard of living. Which means that industry must sell more of its goods to more people. But more people cannot buy more goods unless real wages are increased, and only increased productivity can bring increased wages. For this greater productivity, industry must look to technical advances in process, mechanization of equipment, better management